October 30, 2023

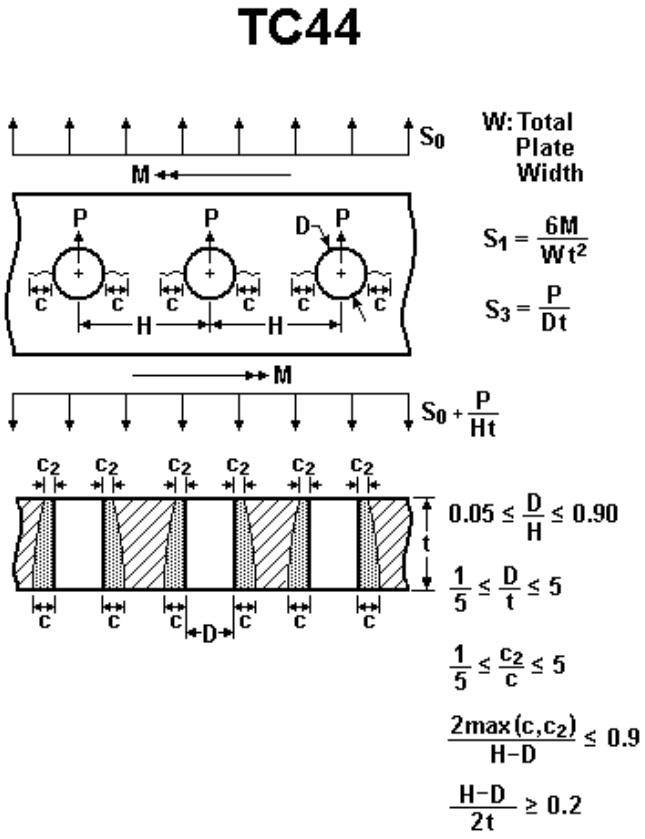
NASGRO v10.2 Release Notes

New and Improved Stress Intensity Factor (SIF) Models

- **New Model for a Curved Through Crack(s) at Hole(s) in Plate with Row of Holes (TC44):**

  Crack case TC44 represents two identical curved through cracks located at every hole in a row of holes. This geometry is similar to TC05, which supports transitions from CC24 if crack tips break through the thickness. (Recall that CC24 is the model for corner cracks at a row of holes in a plate.) However, TC05 enforces a straight crack front and cannot support out-of-plane bending. TC44 was designed to support transitions from CC24 while retaining out-of-plane bending. The new solution features loadings by remote tension, remote in-plane bending, and pin loading. The geometric limits largely support the geometric limits of CC24, though TC44 cannot support very thick plates with small ligaments between holes. In v10.2, TC44 only supports one of the three crack configurations supported by CC24 (two equal cracks at every hole) and we anticipate more configurations in subsequent releases.

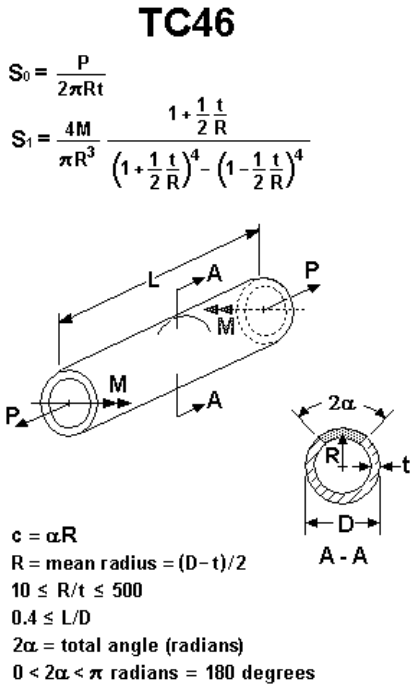
  Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.



- **New Model for a Circumferential Through Crack in Finite Length Thin Cylinder (TC46):**

TC46 represents a straight through circumferential crack in a thin-walled hollow cylinder. The geometry is similar to TC08; however, TC08 is valid only for *long* cylinders having a minimum required length of $L_{min} = 4R\sqrt{R/t}$. The new TC46 model was developed to support *short* cylinder geometries in addition to long cylinders. The cylinder model can be loaded by remote tension and bending stresses.

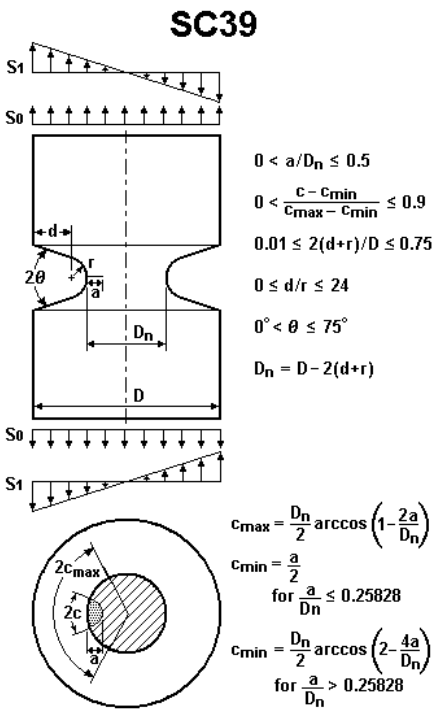
Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.



- **New Model for a Semi-Elliptical Surface Crack in a Notched Round Bar (SC39)**

Crack case SC39 is a solution for a circumferential surface crack in a round notched bar. SC39 supports external surface cracks parameterized using a crack front that intersects the free surface at a normal angle and that supports two degrees of freedom for the crack front. SC39 enables users to define loading histories from remote tension and bending. Currently, SC39 supports a round notch defined by an angled notch with a circular radius. SC39 does not transition to any other crack cases.

Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.

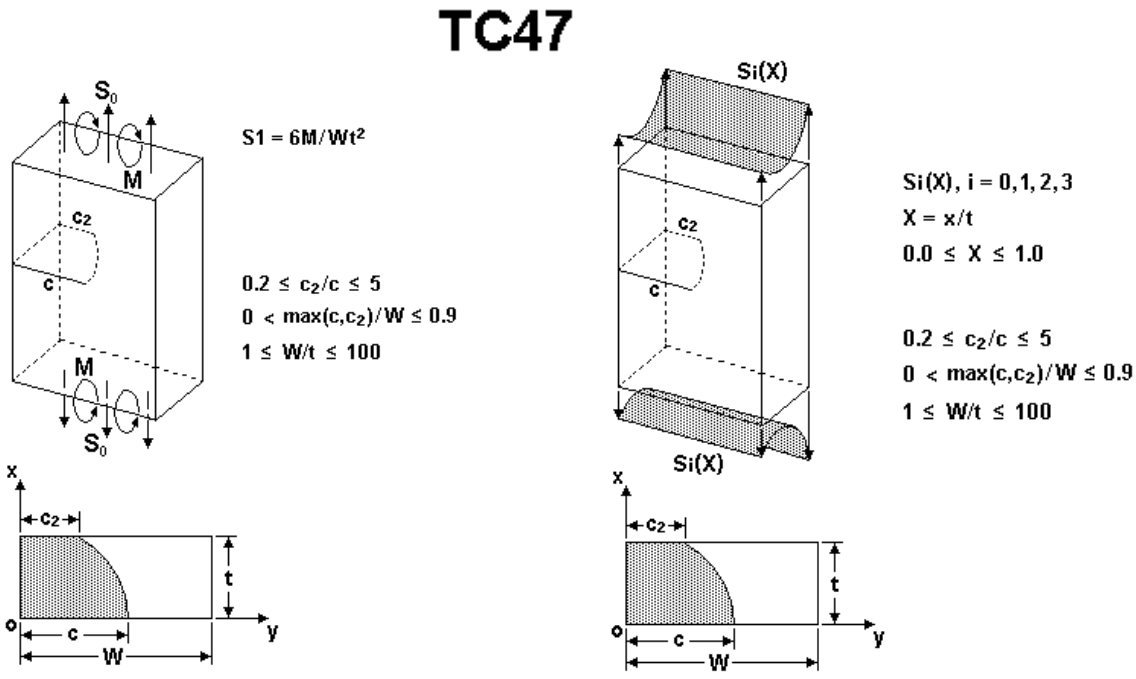


- **New Univariant Weight Function Model for Curved Edge Through Crack (TC47)**

  This new univariant weight function solution models a through crack with a *curved* crack front at the edge of a plate. There are two crack tips, the *c*-tip at the front surface and the c_2-tip at the back surface. These tips have been placed along an assumed curved crack front described by an ellipse with dimensions that exceed the thickness of the plate. TC47 can accept remote tension and linear out-of-plane bending stress loadings (S0 or S1). TC47 can also accept univariant stress gradients applied across the thickness direction.

  TC47 provides improved accuracy relative to results obtained using the functionally equivalent solution TC28 introduced in NASGRO v8.2. TC28 was the first solution built using the new curved-through crack formulation. This solution employed a weight function formulation calibrated from results produced by Abaqus analyses of the equivalent geometry. TC28 tended to under-estimate the actual SIF values, particularly for extremely elongated crack fronts ($c_2/c \rightarrow 0.2$ or $c_2/c \rightarrow 5$) in thin plates ($W/t >> 20$). The new TC47 improves the accuracy of these solutions by calibrating the weight function solutions using additional stress-intensity factor values extracted from StressCheck analyses that do not have the same issues as Abaqus for curved through cracks. Consequently, we recommend TC47 as the preferred solution for this geometry.

  Additional details on the development and verification of TC28 and TC47 will be provided in Appendix C.



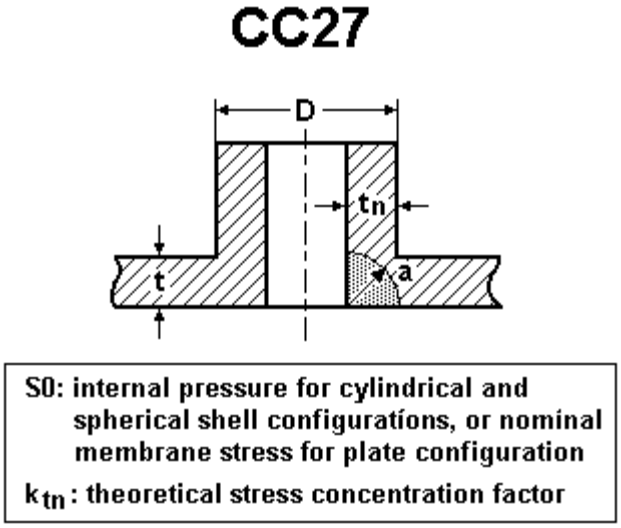
- **New Model for a Corner Crack at a Presure Vessel Nozzle from API 579 (CC27)**

  This model represents a quarter-circular corner crack in a nozzle attached to the shell or head of a pressure vessel. The crack is located at the corner of the connection where the inner surfaces of the shell and the nozzle meet (at the interior 90^o corner). The shell geometry can be selected to be either (1) a cylinder, (2) a sphere, or (3) a flat plate.

  The new CC27 nozzle corner crack solution in NASGRO uses the API 579 solution for the KNCC1 model given in Section 9B.8.1 of API 579 2016 [63] as well as the API 579 reference stress solution (RNCC1). It is an approximate stress intensity solution based on a compounded approach employing a weight function for an embedded penny-shaped crack. The stress gradient is assumed in reference to a hole in an infinite plate subjected to bilateral loads. CC27 considers only a quarter-circular crack, a/c = 1.0.

  The objective of this model is to provide quick access to the nozzle SIF solution from API 579 and secondly, provide a direct comparison with the other new nozzle crack model CC28 solution based on the NASGRO CC26 model that provides more accurate results with more advanced analysis capacities.

  Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.

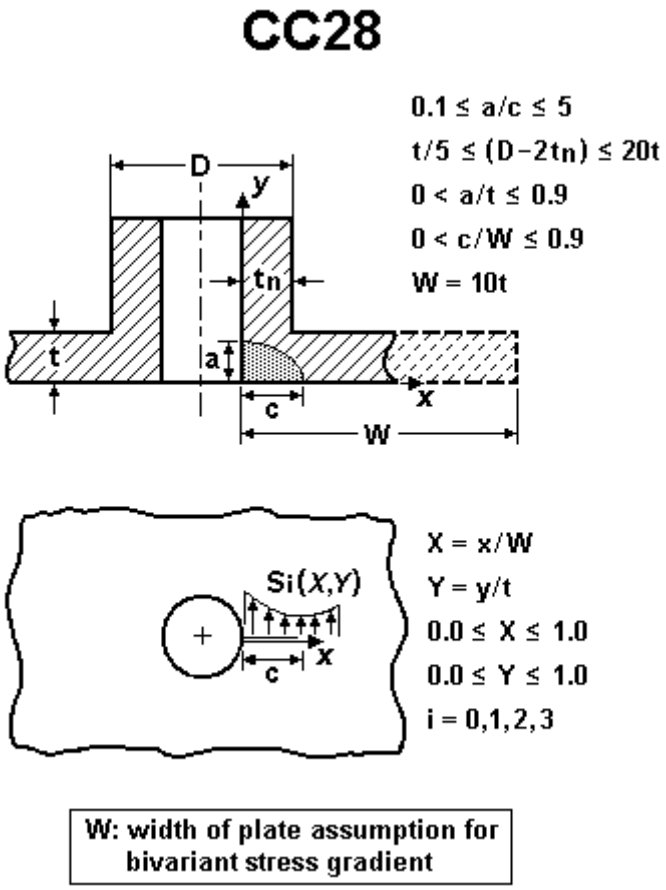


- **New Bivariant Weight Function Model for a Corner Crack at a Presure Vessel Nozzle (CC28)**

  This new bivariant weight function model represents a quarter-elliptical corner crack in a nozzle attached to the shell or head of a pressure vessel. The crack is located at the corner of the connection where the inner surfaces of the shell and the nozzle meet (at the interior 90^o corner). The geometry is loaded by bivariant (2-D) crack plane stress distributions. This model is different from CC27 for (1) its capability to handle a much wider range of crack shape aspect ratio, (2) the usage of user-specified gradients across the section, and (3) the access to unique NASGRO analysis features such as shakedown and residual stress.

  The core computing engine of this crack case for SIFs is based on CC26. In view of a rectangular cross section required with the definition of bivariant stress gradients, *W* is internally defined as a pseudo net section width of the crack model (see the dashed rectangular section in the figure). This length parameter is assumed to be ten times the shell thickness. Note the constraint on the length parameter *W* is not based on the nozzle/shell configuration. Instead, it is specified to be in accordance with the solution paradigm for CC26 and to approximate the shallow curvature of a large diameter shell and to facilitate the specification of the bivariant stress gradient.

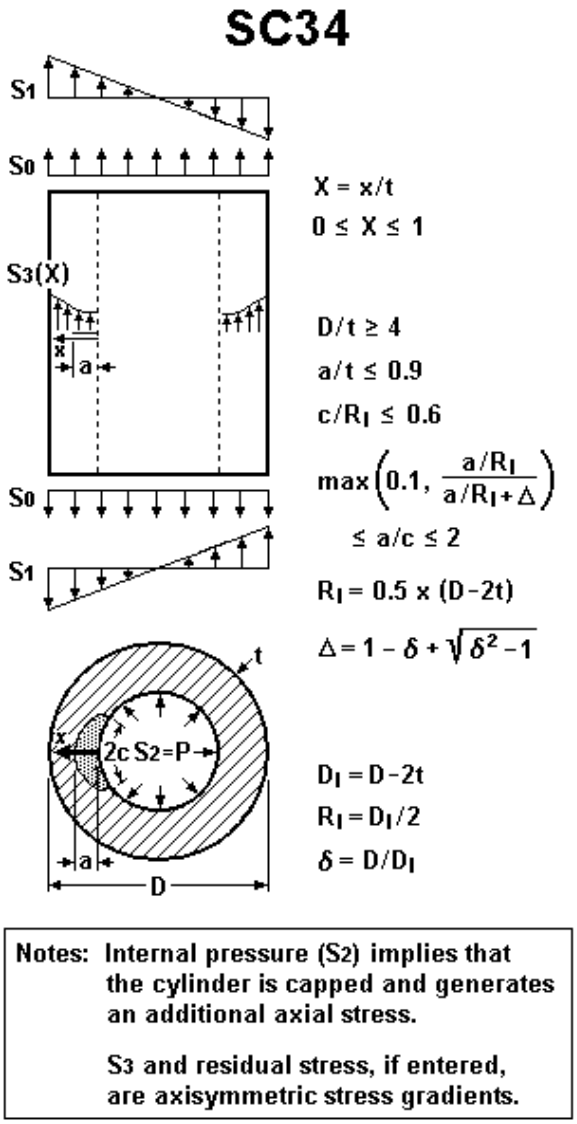
  Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.



- **Addition of Internal Circumferential Surface Crack in Hollow Cylinder Model for SC34:**

  Crack case SC34 is a weight function solution for a surface crack in a hollow cylinder. Previously, the crack could only be located on the external surface. A new solution has now been added to SC34 that supports a surface crack on the internal cylindrical surface. The user can select an internal or external crack location via a radio button on the SC34 GUI. The internal crack is now the default option. SC34 supports the loadings and geometries shown on the right of the figure. It also supports axisymmetric stresses in the cylinder as service loadings and residual stresses.

  Additional detail on the development of this new model is contained in Appendix C of the Reference Manual.



- **Expanded Solution Limits and Other SIF Model Improvements:**

  - ***Expansion of CC24 to support a single crack at a single hole in a row of holes***

    Crack case CC24 previously supported two identical corner cracks at either a single hole in a row of holes or at every hole in a row holes. NASGRO v10.2 completes the main development of CC24 by supporting a single crack at a single hole in a row of holes. There is a set of radio buttons in CC24 to switch between these different geometric configurations. The new solution with a single crack at a single hole in a row of holes is now the default solution.

    The geometric limits remain largely consistent in all crack case configurations, though cracks placed at a single hole can be longer than cracks placed at every hole. CC24 continues to support S0, S1, and S3 loading remotely. It can transition to TC05 (for all configurations) or to TC44 (for two identical cracks at every hole) if the crack tip breaks through the thickness. TC44 enables users to maintain S1 loading after transition.

  - ***Expansion of CC26 limits and loading***

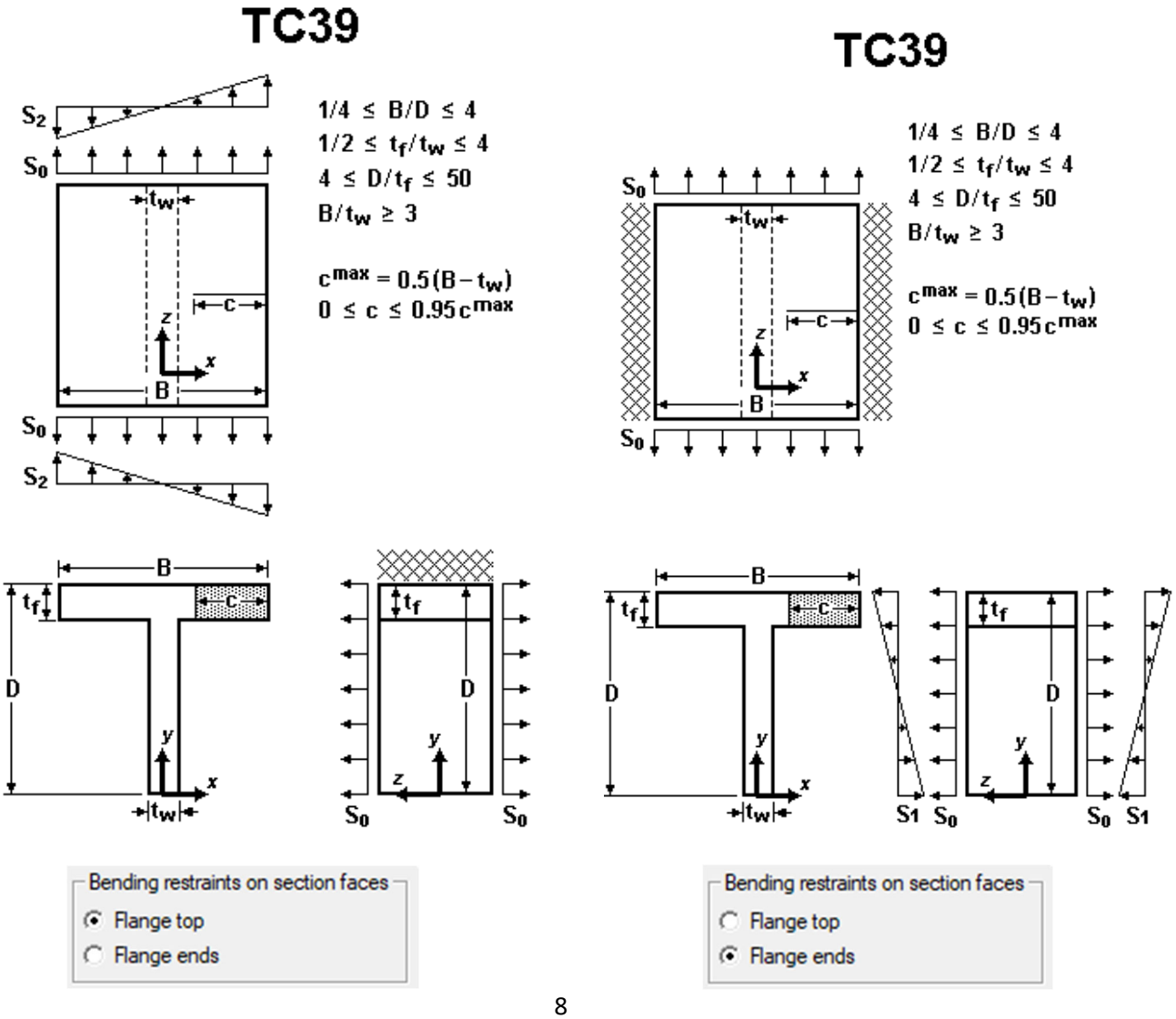
    Crack case CC26 is a bivariant weight function solution for a quarter-elliptical corner crack at an offset hole in a plate. CC26 was introduced to provide increased accuracy vs. CC10 that has the same geometry and formulation. Consequently, CC26 had geometric limits that matched the geometric limits for CC10. In v10.2, NASGRO expands the geometric limits for CC26 to align it with the geometric limits for CC08, a similar geometry with much wider limits and a univariant weight function formulation. These new limits support more extreme crack shapes, smaller/larger hole diameters (relative to thickness), and larger offsets. At this time, CC26 is limited to cracks on the short ligament.

    Previously, users of CC26 were required to supply their own stresses for the uncracked ligament for every loading condition. This requirement limited the usage of CC26 due to the difficulty of computing accurate crack plane stresses and converting them into the NASGRO format for bivariant stresses. In v10.2, CC26 now provides estimates of bivariant crack plane stresses for all supported geometries and for the remote loadings from uniform tension, in-plane bending, out-of-plane bending, and pin loading. These loadings are generated using a new methodology described in Appendix C that combines principal component analysis of the stresses calculated by finite element methods with weights generated by Gaussian Process models. With these remote loadings, CC26 is the first solution in NASGRO that natively supports the four primary remote loadings, residual stresses, and shakedown.

- ***Expansion of Restraint Condition for a Through Crack in a T-Section (TC39)***

Crack case TC39 is a solution for a through thickness edge crack in a structural member with a cross-section idealized as a generic T-section. Previously, this solution only had one restraint condition (on the top of the flange) and supported the loadings of remote uniform tension and remote bending about the Y-axis. In v10.2, TC39 now permits a second restraint condition on the ends of the flanges and enables users to define remote uniform tension and remote bending about the X-axis.

This solution assumes that cracks start in the flange edge and advance towards the intersection of the flange with the web. At this intersection, the crack bifurcates into two cracks with one located on the flange and another located on the web. These two cracks then grow independently. This solution restrains the crack front to be straight and perpendicular to the free surface throughout fatigue crack growth. This solution does not support cracks within some small distance from the intersection.



Multiple Temperature Analysis Capability Additions

The shakedown and FAD capabilities in NASFLA were not originally developed for multiple-temperature applications, and so their previous implementation did not fully support multiple temperatures. The temperature actually used for shakedown or FAD in multiple-temperature mode was typically the last temperature displayed on the Material GUI screen.

New multiple-temperature capabilities have now been introduced for NASFLA shakedown and FAD analyses. The approach is slightly different for shakedown versus FAD. The temperature used for shakedown calculations in multiple-temperature mode is now the temperature associated with the load step having the maximum stress among all load blocks, which is the load step used for shakedown analysis.

For FAD analyses in NASFLA, the temperature used to calculate the failure assessment lines (FAL) and the (Kr, Lr) points is now based on the specified temperature for each load step, and hence can vary from load step to load step. The graphical representation of FAD in the NASFLA GUI will show the FAL and the (Kr, Lr) curves for the temperature associated with the load step causing failure.

Appropriate temperature-dependent material properties used in shakedown and FAD computations are determined by interpolation among the properties at the temperatures included in the database for the selected material.

Additional details are provided in Appendix P of the Reference Manual.

Input/Output Improvements

- ***Printout of Initial Crack Size Geometry Factors F_i and G_i***

  Previous versions of NASGRO did not provide a printout of the SIF geometry factors (F_i) and the net section stress geometry factors (G_i) for the initial crack size (before crack growth occurs). This information for the initial crack size is now printed on the first line of the OUT2 file as shown below under the primary column labels: “F Values” and “G Values”.

ax(c)	F0(a)	F0(c)	F1(a)	F1(c)	G0	G1	da/d
x	0.7189053E+00	0.7345766E+00	0.7189053E+00	0.7345766E+00	0.1007443E+01	0.1007443E+01	x
0510E+02	0.7201226E+00	0.7359557E+00	0.7201226E+00	0.7359557E+00	0.1008251E+01	0.1008251E+01	0.421800
1328E+02	0.7212890E+00	0.7374040E+00	0.7212890E+00	0.7374040E+00	0.1009103E+01	0.1009103E+01	0.460990
1534E+02	0.7224088E+00	0.7388911E+00	0.7224088E+00	0.7388911E+00	0.1009995E+01	0.1009995E+01	0.501484
1438E+02	0.7235110E+00	0.7404466E+00	0.7235110E+00	0.7404466E+00	0.1010932E+01	0.1010932E+01	0.543624
1143E+02	0.7246178E+00	0.7420917E+00	0.7246178E+00	0.7420917E+00	0.1011917E+01	0.1011917E+01	0.587523

- ***New Warning Messages when Stress Quantities are Lost During Transition***

Many crack cases in NASGRO have crack growth transition capabilities, i.e. the crack in one crack model can evolve into another crack as the crack propagates. For example, CC01 (a corner crack) can transition to TC02 (a through crack). For most of the available transitions, the load conditions before and after transition are fully consistent, however, in some cases, the loading for the original crack model is not fully carried over to the post-transition model. In version v10.2, we fully examined the load consistency for all the transitions, collected and classified the transitions with load conditions that are not fully carried over, and now print a warning message to the output file (the .out1 file) corresponding to how the stresses are converted for the post-transition case.

There are six groups of transition possibilities as described below. The warning message that is now printed for each of these cases is shown in italics font.

- **Group 1:**
  Transitions with load condition fully carried over.
  No warning printed.

- **Group 2:**
  Transitions with S3 converted to S0 and S2 after transition, e.g., TC23-to-TC19.
  Warning message: *S3 converted to S0 and S2 after transition.*

- **Group 3:**
  Transitions with equivalent remote loading applied on post-transition model, e.g., SC02-to-TC01.
  Warning message: *Equivalent remote loading applied on post-transition model.*

- **Group 4:**
  Transitions with membrane bending effects lost after transition, e.g., SC04-to-TC07.
  Warning message: *Membrane bending effects lost after transition.*

- **Group 5:**
  Transitions with some bending effects (either in-plane bending or out-of-plane bending) lost after transition, e.g., SC31-to-TC12 and SC30-to-TC11.
  Warning messages: *In-plane bending effects lost after transition* or *Out-of-plane bending effects lost after transition.*

- **Group 6:**
  Transitions with some stress component simply dropped, e.g., SC03-to-TC06, which is the only transition in this group.
  Warning message: *S4 of SC03 ignored after transition.*

Documentation Improvements

The Reference Manual has undergone significant improvements in recent years, and those improvements continue. In addition to adding or updating the Appendix C sections for each of the crack cases described above to reflect new features and capabilities, the following changes were made for this version:

- Section 2.2.5 titled "Entering Initial Flaw Size" was revised to present the current NDE options provided in the GUI. The "NASA Standard NDE Flaw Sizes" tables were expanded to encompass all the latest cases along with their corresponding NDE initial flaw sizes. The obsolete tables were removed from this section for clarity and conciseness.

- Appendix B was expanded to include new sections for TC44, TC46, SC39, and updated sections for TC39, CC24 and SC34.

- Appendix C was expanded to include new SIF model descriptions for the crack cases TC44, TC46, TC47, CC27, CC28, SC39, and updated sections for TC28, TC39, CC24, CC26 and SC34.

- Appendix D was expanded to include new sections for TC44, TC47, CC20, and updated sections for TC39 and CC24.

- Appendix G was updated to include a new section that lists the 2-D tabular *da/dN* sets for layered pressure vessel steels that were added to the NASFLA material database in v10.1.

- Appendix I was converted to LaTeX with consistent structure and formatting rules with the rest of the new documents. The content and figures were updated as needed.

- Appendices U and V on Rules for Fracture Toughness and Constraint Coefficient and Appendix X on Alternative Failure Criteria were transferred to the new LaTeX documentation system with the following updates and improvements:

    - The document follows the consistent format with the rest of the Latex based documentation in terms of section/figure/table/equation numbering, citations, referencing, bookmarks, etc.

    - The text references to GUI items are displayed in bold typeface for extra clarity.

    - The tables in Appendix X (which were originally pictures) were converted to numeric text for consistency in format and notations.

    - The tables in Appendices U and V were updated to include the criteria used for the recently introduced cases TC28, TC29, TC39, TC43, TC44, TC47, CC24, CC26, CC27, CC28, SC36, SC37, SC38 and SC39.

- Two new sections were added to Appendix X describing the formulations used for the newly introduced NASFAD crack cases CC27 and CC28.

Graphical User Interface Improvements

The graphical user interfaces (GUIs) for a number of the NASGRO modules have been upgraded to be more flexible and dynamic. This is an ongoing process that has for recent versions included converting GUIs to be fully dynamic layouts, adjusting controls for different screen resolutions, enabling scrolling of the entire GUI pane, and retaining proper layouts when changing the GUI size. These updates continue to improve many of the various pop-up dialogs to accommodate different screen and/or font sizes. Implementation of additional dynamic dialogs are planned.

NASGRO v10.2a Additions, Changes, and Fixes by NASGRO Module

April 25, 2023

	Applicable NASGRO Module											
Category	NASGRO Main	Config Control	NASFLA	NASSIF	NASCCS	NASGLS	NASFAD	NASMAT	NASBEM	NASFORM	Users Manual	**Description**
Addition			X									Implemented the environmental crack growth threshold (Keac) check under limit stresses, i.e. K(limit) > Keac check, for all the crack cases under all the retardation models.
Addition								X				Established the regression testing enviroment for NASMAT Fortran code with: - 5 input files and the standard results for da/dN fitting; - 5 input files and the standard results for DKth fitting; - 2 input files and the standard results for Cth-to-Fth and Fth-to-Cth conversion.
Change								X				Improved NASMAT Fortran code quality by: - Forcing explicit type declaration; - Forcing data flow declaration; - Changing floating-point variables from single precision to double precision; - Replacing common blocks by data modules; - Replacing redundant code segments spread in different files by functions; - Replacing hard-coded parameters by symbolic constants.
Change			X	X	X							Updated the crack size limit check for crack case TC23. Improved the output of the final results of TC23 for NASFLA and NASCCS analysis
Fix			X				X					The state of the various FAD checkboxes on the Material tab was not being saved or loaded for multi-temperature data.
Fix			X									A previously incomplete expansion in the code of the size of the "Parameter analysis" grid on the Computations tab caused the values in the corresponding "Scale factors" grid to be read incorrectly from input file. The previously missing internal constant variable value has now been properly assigned.
Fix			X									Inconsistent column labels in OUT2 with displacement quantities when TC14 crack model was used. The numeric IDs with remote tensile and in-plane bend displacements had been revised for consistency. The normalized SIFs are now designated by F0 and F2, instead of F0 and F1.
Fix			X									A memory allocation issue was found during development when CC20 transitioned into TC14 in Debug mode.
Fix			X		X	X						Crack case SC37: An incorrect implementation of the GUI solution limits checking code for the requirement: "2T/t cannot be less than 0.05 nor exceed 1.95" caused an error message to be issued for valid geometry values.
Fix					X							Crack case TC29: An error in the naming of some plot files prevented the plotting of data for the output format "Plot solutions" after running the analysis and choosing "View plots" on the Computations tab.
Fix			X		X	X						Crack cases TC28, TC29: The GUI solution limits error checks for calculating the max of c and c2 caused an inadvertent error when the value of c2/c equaled 1.
Fix				X								Crack cases utilizing univariant stress files were rejected for X-coordinate stress points not being equally spaced, despite this not being a requirement for those file types.
Fix			X									Using the "Parameter Analysis" option in the NASFLA GUI's Computations tab, the code that does file management for multiple runs was mishandling the appending of "-run n" to the ends of the files, causing no output files to be copied back to the input file directory after the runs had completed.
Fix								X				Fixed a coding error in DKth fitting for negative R with only one (R, DKth) data point. Before the bug fix, the fitting result of Cthm given by NASMAT was wrong.
Fix								X				Fixed a coding error in da/dN fitting for the Walker equation for positive R data, which would lower the convergence speed of the iteration for solving the equation system, or even make the iteration not converge.
Fix						X						NASGLS analysis for symmetric SC30 case terminated with an error. An error message found in OUT1 files showed that the crack type was not correctly initialized. Once the initialization issue was resolved, the analysis ran to completion.
Fix			X	X	X	X	X					The geometry tab would occasionally freeze when selecting a new crack case and then changing tabs.
Fix			X									Incorrect crack tip label with c2-tip contained in "crack transition information" section in OUT1 files. This issue unfolded from CC01 transitioning to TC28 where a crack tip label "cB" showed up in the "crack transition information" section.
Fix			X	X	X	X	X					In the NASFLA GUI, after an analysis has been run, on the Computations tab, the functionality for the button "Save window contents to doc file" had been inadvertently disabled. The routine that writes this data to an external .doc file was rewritten to re-enable this feature.
Fix			X									Missing some post-transition description in crack transition information section in OUT1 file from CC09 to TC28. Some of post-transition description relating to updated geometric information with TC28 was not displayed in OUT1 files.
Fix			X									Inconsistent crack tip labels in crack transition information section with transition path from SC30 to TC28. The output with the last transition crack model TC28 referring to c- and a-tips was corrected for consistency.
Fix			X									Misaligned message from strip yield model for extracted thickness information was found. The displayed message is now aligned with the echo for load block definition.
Fix			X									TC28 subjected to remote loads and restrained bend not working with residual stress or shakedown feature enabled. The list in a check for a combined scenario from remote loads, restrained bend, and residual stress or shakedown was found not including TC28 crack case.
Fix			X									Very large number of cycles not displayed properly in OUT1 files and GUI. To resolve, the display format for the specific column was switched to the usage of scientific format.

NASGRO v10.2a Additions, Changes, and Fixes by NASGRO Module

April 25, 2023

Category	Applicable NASGRO Module											Description
	NASGRO Main	Config Control	NASFLA	NASSIF	NASCCS	NASGLS	NASFAD	NASMAT	NASBEM	NASFORM	Users Manual	
Fix			X		X	X						Crack case CC08: An internal code loop error prevented the Residual Stress table from being plotted.
Fix				X								Specified NASSIF plot limits along y-axis having no effect as depicted in plot. The SIFBAT format was correct.
Fix			X	X								Stress plot for clustered stress points appearing inconsistent with those from v9.21f. The update now provides consistent plots with those from v9.21f.
Fix			X									On the NASFLA GUI Material tab, for the "Select failure criteria" section on the left side, the footnote text reminder "*(must specify stress and strain material properties)" was inadvertently removed from a prior NASGRO version. This text note has now been added back in, and will be displayed on the selecton of either "FAD:Fitnet Option 3" or "FAD: API 579 L3 Method B" failure criterion.
Fix			X									When attempting to save "All calculated data to csv files" in the NASFLA GUI Computations tab, the code that reads the output would get stuck in an inner loop, repeatedly writing out the last line of data to a CSV file, but not ending. A new breakout condition was implemented which prevents this erroneous rewrite, to properly create the csv output file.
Fix				X								The plot solutions options on the OutputOptions tab would occasionally become active for TC28.
Fix			X									Crack case TC29: Internal case tip configuration management code has been corrected that was preventing the post processing plotting of some data.
Fix			X		X	X						Crack case TC29: An incorrect internal variable setting prevented the "Plot stresses" button's functionality, for the "Tabular input" selection of the "Crack plane stress definition from" radiobox.
Fix			X		X	X	X					Crack case TC13: Incorrect geometry values error checking code for the crack in the long ligament prevented the analysis from being run.
Fix					X							Crack case SC26: Incorrect geometry values error checking code caused an error message to be issued for valid data, preventing the analysis from being run.
Fix			X									The dye penetrant NDE option would not always properly convert across unit types.
Fix			X									Crack case CC08: Loading an older input file did not retain the transition to crack case TC13 of that analysis, which at that time was the only option. Instead,the older input file load erroneously defaulted to the newer (default) transition option of crack case TC43. This has been corrected to properly retain the transition to crack case TC13.
Fix			X									Crack case SC01: An incorrect internal data index inadvertently caused the solution limits checking code for the crack ratio limit to be bypassed, allowing invalid data to be run.
Fix			X		X	X						Crack case TC35: In the "Crack plane stress definition from" radiobox, the selection of "Tabular input" was correctly disabled when selecting the "Restrained" option for "Bending restraints at remote ends," but this selection was not being correctly re-enabled when a new crack case was selected.
Fix			X									When entering 2-D tabular new data under "Same da/dN set for all R", the da/dN and dK values would not be properly converted across unit types.
Fix				X								The plot code was not always properly flagging 1 and 2D cases correctly for plotting.
Fix							X					Geometry grid labels and values for crack size and crack aspect ratio could sometimes be corrupted due to NASFAD inadvertently calling NASFLA-only code.
Fix								X				Material M7GJ12AB01B was incorrectly labeled as "7075" in the description, instead of 7050.
Fix						X						NASGLS had an access violation issue that occasionally could cause the GUI to crash.
Fix			X									CC28 was not correctly checking the OPS flag before checks on the bivariant stress files, leading to the possibility of invalid stress files being sent to the DLL.
Fix			X									Crack case SC34: The GUI code that handles file management for multiple runs using the "Parameter Analysis" grid on the Computations tab was outdated, and still used an older file naming convention, causing some output files to be misnamed and overwritten.
Fix					X							CC26's GUI-based geometry checks were using the incorrect limit of "0.5" instead of "0.1."
Fix			X									When loading an input file, the analysis mode would be reset even if the load was canceled.
Fix			X		X							Crack case TC39: The batchfile was missing some SIF compounding data for the c1,c2 tip configuration due to a mismatch between how the data is read from input file vs. how it is stored internally and then read from that internal storage to write to the batchfile.
Fix			X									Bivariant shakedown failed from zero stress points in stress gradient definition. A numerical issue from scaling stress components by "exact" zero stress during iterations was identified.

NASGRO v10.2b Additions, Changes, and Fixes by NASGRO Module

August 18, 2023

Category	Applicable NASGRO Module											Description
	NASGRO Main	Config Control	NASFLA	NASSIF	NASCCS	NASGLS	NASFAD	NASMAT	NASBEM	NASFORM	Users Manual	
Addition			X	X	X	X	X					The following two user-selected directories will now be remembered by the GUIs for the duration of the current session, and will also be saved to the .INI file whenever the option "Save options now" or "Save options on exit" are chosen: (1) the directory to which a crack case bitmap file (.BMP) is saved, using the "Save diagram to file" button on the Geometry tab (all GUIs), and (2) the directory from which a NASFLA user material file is selected, using the "User file:" button on the Material tab (after selecting "User material file" from "Data source:") (NASFLA GUI). Once selected, if either button is again clicked, the last directory selected will be used again as a starting point in the save file, or select file, functionality.
Change			X	X	X							Enhancements were implemented to better capture the SIF behaviors from interpolation. Those included additional reference solutions between c2/c=0.8 and 1.0 for refinement and a weighted Hermite interpolative approach for steep variations.
Change			X	X	X							Crack cases TC08, SC03, SC05: More recently developed crack cases are now recommended for these less recently developed crack cases, in the Crack Case Library selection dialog. TC46 is now recommended when selecting TC08, SC36 is now recommended when selecting SC03, and SC34 is now recommended when selecting SC05.
Change			X									The NASA std NDE for initial flaw option (initial flaw sizes and detection types) has been enabled in the NASFLA GUI (and the corresponding tables updated in the user manual that contains these NDE values) for the following crack cases: TC39, TC40, CC18, CC24, SC34, SC36, SC39.
Fix			X									Only the first load pair in spectrum was used in EPFM fatigue crack growth computation. The fix resolves the consistency in the definition of load steps, blocks, and schedules between NASGRO LEFM and EPFM.
Fix			X									An error in the geometry validation routine for an external file in alternative 2D format resulted in an incorrect determination of the file's equal spacing, resulting in a non-equally spaced stress file to be allowed for the analysis.
Fix			X									Crack case CC26: An incorrect logic path in the code caused the GUI to require individual stress files when remote stresses were selected, resulting in error messages being displayed and preventing the anaysis from running.
Fix			X	X	X		X					Crack case CC28: An internal flag was not being set correctly for this crack case, preventing the plotting function.
Fix			X	X	X		X					Crack case CC28: In the validation routine for an external file in alternative 2D format, an error when calculating the maximum possible values for x and y caused an incorrect error message to be displayed, preventing the analysis from running.
Fix			X									Extreme offset CC26 showing unusual low SIF at c-tip when subjected to remote tension. The reference solutions with extreme offset at B/b=0.1 were revised from data extraction error.
Fix			X									GUI issued an incorrect error when stress files with OPS enabled were used with the number of points exceeding 500.
Fix								X				NASMAT GUI was allowing users to enter one more R value than the computation engine allows when plotting fits.
Fix								X				NASMAT incorrectly rounding R value to 1 decimal place rather than 2 when entering a vs N data.
Fix			X									For elastic-plastic mode, the secondary load values entered and displayed in the grid on the Load Blocks tab were not correctly saved to internal storage when entered using the clipboard Copy and Paste function, preventing that data from being saved to an input file, or to be used in an analysis run, since the souce of the data when writing to both input file and batch file is the GUI's internal storage, not what is shown on-screen.
Fix			X									For elastic-plastic mode, the on-screen grid that displays the secondary load values for each step in the block was not being cleared after a new input file was loaded or a new project was started, causing the previous run's grid values to erroneously remain on-screen.
Fix			X									The NASFLA GUI would crash during the use of the Compare Two IDS dialog, whenever certain buttons in that dialog were clicked, including the "Save ID and Close" button at the bottom. This was caused by too large of an internal function that grouped many button events together, and was solved by dividing this single unified function into several separate smaller functions.
Fix			X									Cleaned up inconsistent description in OUT1 and SCREEN.OUT files from EPFM analysis. The effort was to resolve an inconsistency between GUI and output files; GUI only allowed one load block case definition, but output files would show multiple block cases. The revision changes the label in output files to 'load steps' instead of 'block cases.'
Fix			X	X	X							OPS routine throwing errors when external stress files containing 855 data pairs were used. The revision applied a fix to remove such an internal cap.
Fix						X						NASGLS did not print K values for crack tip c for 2D cases for block and step output. A data format bug during the transition of software structure from v8.2 to v9.0 was introduced. It led to an offset to the left with the columns related to crack depths and their SIFs for 2D crack models.

NASGRO v10.2b Additions, Changes, and Fixes by NASGRO Module

August 18, 2023

	Applicable NASGRO Module											
Category	NASGRO Main	Config Control	NASFLA	NASSIF	NASCCS	NASGLS	NASFAD	NASMAT	NASBEM	NASFORM	Users Manual	**Description**
Fix			X									For elastic-plastic mode, during crack case selection, the controls for newer crack cases that are recommended in linear-elastic mode (a text box and recommended crack case button) were erroneously being displayed in the crack case library dialog.
Fix			X									An incorrect source code index used during the reading of the input file for elastic-plastic secondary load values caused the load values for step 1 of the block to be incorrectly applied to each step in the block, whether that step had its own secondary load values or not.
Fix			X									Crack case CC01: For elastic-plastic mode, the radio box "Post-transition geometry option" was being inadvertently displayed, which does not apply to elastic-plastic mode. This option applies only to linear elastic mode.
Fix			X									When adding new data without selecting a crack case, the FAD controls would erroneously appear and be active.
Fix											X	Fixed the example file content for the 2D alternative stress input in Appendix C.
Fix			X		X							Crack case TC44: An incorrect geometry validation caused an error to be issued when the initial values for c2 and c were equal, preventing the analysis from running.
Fix			X									When switching to elastic-plastic and selecting a crack case, the GUI would sometimes not display controls on tabs.
Fix					X							No output from NASCCS with SC39 for critical crack size from fatigue crack growth threshold option. The erroneous scenario was identified from the inconsistent upper bound with the crack depth used in the iteration bracket employed by the implicit analysis. The same fix was also applied to the similar issue identifiable with SC35.
Fix			X	X								Crack case SC26: For the ellipitical notch shape configuration, an error in the geometry validation routine caused a valid input value of zero for "Edge distance, B" to return an error, preventing the analysis from running.
Fix			X									When changing the NASFLA GUI from linear elastic to elastic-plastic mode, if the analysis type was previously set to inverse mode ("Calculate initial flaw size, given target life"), that option was not reset and remained in inverse mode, which caused the resulting geometry grid that was subsequently displayed for elastic-plastic to be missing the crack size entry row. This is correct for linear elastic inverse mode, but inverse mode does not apply to elastic-plastic, for which crack size should always be displayed.
Fix				X								OUT files from NASSIF analysis to compute CFs with TC44 showing all zeros in columns displaying normalized SIFs. An un-initialized variable was found with this crack case leading to zero values in whole columns after normalization.
Fix				X								Crack case TC44: Updated the crack tip labels on the Output Options tab in the "Plot solutions" controls for this crack case to reflect the actual crack tips 'c' and 'c2' labels instead of the generic 'a' and 'c' default values which were being displayed
Fix			X									Misleading label denoting crack shape aspect ratio found in iteration table with TC44. This was identified in indirect analysis to compute an initial flaw size. Two mislabels were found: one in the section showing the initial crack aspect ratio and the other in the iteration table.
Fix			X									Inconsistency between SC06 NASFLA results from manually-input load block and externally specified load block. It's found the routines to compute force from both approaches were different; the one for externally specified load block definitions was out-of-date.
Fix			X	X	X							Crack case CC26: When remote stresses are selected and also a user residual stress file, that file was unable to be plotted using the Plot Stresses button.
Fix			X									Inconsistency in displayed bivariant gradient with CC28 when OPS was used. The columns designating the normalized coordinates were found not showing values between 0 and 1. The error was isolated driving from the incorrect selection of length parameter used for normalization.
Fix				X								NASSIF SC31 not printing results for multiple a/c values. The parser was found not behaving in sync with the batch file generated by GUI when accounting for crack size definitions after the first row.
Fix			X									An internal flag to invoke NSY computation after transition from CC26 to TC43 was incorrectly assigned. The inconsistency was unfolded when CC26 was subjected to remote loads, not crack plane stresses.

NASGRO v10.2f Additions, Changes, and Fixes by NASGRO Module

October 30, 2023

	Applicable NASGRO Module											
Category	NASGRO Main	Config Control	NASFLA	NASSIF	NASCCS	NASGLS	NASFAD	NASMAT	NASBEM	NASFORM	Users Manual	**Description**
Fix			X									Crack case TC38: An extraneous line of code caused the batchfile to contain an error, in turn causing the GUI to crash, when the "Initial flaw option" of "NASA std NDE" was chosen.
Fix			X									TC38 NASFLA in Debug mode crashed the DLL.
Fix			X									Zero threshold values printed in OUT1 file for the description with low margin. A zero value was incorrectly assigned as the threshold when negative maximum SIF value in load pairs was encountered. The inconsistency led to incorrect low margin in the description.
Fix					X							Crack case TC28, which is a valid case for NASCCS, appeared for selection correctly in the standard "Crack type: Through Cracks" category listing in the Crack Case Library dialog, but was missing from the "Cracked body type: Plate" category listing.
Fix				X								Crack case SC33, which is a valid case for NASSIF, appeared for selection correctly in the standard "Crack type: Surface Cracks" category listing in the Crack Case Library dialog, but was missing from the "Cracked body type: Plate" category listing.
Fix			X									Questionable K(limit) values at Final Results section in OUT1 file with usage of TC39. An inconsistency was found from reference to the crack length used for normalization when computing K(limit).
Fix					X							Crack case CC26: The "Negative Pin Load (Bearing Stress) Assumption" radiobox was initially shown correctly on the Geometry tab, when the case was first selected and the "Crack plane stress definition" radiobox was set to "Tension, bends, pin load." This option erroneously remained on-screen when the "Crack plane stress definition" radiobox was changed to "Tabular input."
Fix			X									Column output in OUT2 files for correction factors with CC18 appeared not aligned correctly between the first and the rest of the data lines. The crack tip assignment to the columns with the first data line was not initiated in accordance with the rest.
Fix			X		X							When loading a material from a user material file with a name or path different from the NASGRO-provided user file, the material selection dialogue would not properly fill the dialogue with the correct information from the selected user file. Loading input files with user files that did not match the default ones would also cause issues with both selecting a material and loading the material from file.
Fix			X									When loading multi-temperature user material file data without the optional <History></History> tags, Nasfla would crash upon switching from and then back to the Material tab. Material data could also become corrupted, preventing computation, even if the crash did not occur
Fix			X									TC47 crack length on back surface was growing larger than the crack length on the front when subjected to remote tension. Three bugs were identified after investigation and were corrected to address the inconsistency from diverging c2/c ratio.
Fix			X									Crack case CC26: The "Negative Pin Load (Bearing Stress) Assumption" radiobox was initially shown correctly on the Geometry tab, when the case was first selected and the "Crack plane stress definition" radiobox was set to "Tension, bends, pin load." However, if the stress selection was changed to "Tabular input" (where the negative pinload option does not apply and is correctly removed from the screen), and then back to "Tension, bends, pin load," the radiobox was not displayed on-screen.
Fix			X									The display format in scratch file was found inadequate for showing large numbers during analysis with cyclic shakedown.
Fix			X									Revision required to provide more descriptive message for very large number of cycles specified in block case definition. The current error caught by DLLs and displayed in SCREEN.OUT was revised to be more descriptive.
Fix			X									Symmetric TC29 incorrectly transitioned into TC47 - an edge curved through thickness crack. The error was found from inconsistent implementation of the transition from local failure.
Fix			X									Crack case TC17: When subject to remote load and restrained bending, S1 fields are being erroneously shown on several tabs, when only S0 is available. Also, the SIF Compounding labels would not update properly when SIF Compounding was selected and the restrained bending option changed.
Fix			X									When plotting user material file multiple temperature data, the Basic Fit portion of the presented dialog was not deactivated as it should have been. This option should be available for NASA data only.
Fix			X									Crack cases TC28, TC47: When plotting post-processing data, the X-axis of the displayed plot image was incorrectly labeled with a default tip value of either 'a' or 'c' instead of using the user-selected tip choice of 'c' or 'c2'.
Fix			X									In certain instances, the NASFLA GUI would crash due to an internal stack overflow when attempting to plot basic fits of multiple temperature data.