NASGRO®
Fracture Mechanics & Fatigue Crack Growth Analysis Software

NASGRO is a suite of programs used to analyze fracture and fatigue crack growth (FCG) in structures and mechanical components. The software is developed jointly by Southwest Research Institute® (SwRI®) and NASA under a Space Act Agreement, with additional support from the NASGRO Consortium and the Federal Aviation Administration.

NASGRO consists of integrated modules with user-friendly graphical interfaces that:
- Calculate stress intensity factors (*K*), FCG life, and critical crack size
- Store, retrieve, and curve-fit FCG and fracture toughness data

NASGRO is the most widely used fracture mechanics and FCG software in the world today.

Recent Enhancements
Recent enhancements in the current version 11.0 include:
- New bivariant weight function (WF) *K* solution for curved through crack at edge of plate
- New *K* solution for through crack growing toward hole
- New *K* solution for corner crack in T-section flange
- Expansion of *K* solution for two curved through cracks at single hole in row of holes
- Expansion of *K* solution for corner crack on long ligament side of hole
- Expansion of *K* solution for surface crack at elliptical notch in round bar
- Elastic-plastic fracture mechanics (EPFM) module improvements
- Capability to use API 579 fracture toughness values
- Option to select API 579 transition (recharacterization) criteria
- Option to select API 579 weld residual stress (WRS) polynomial equations

Future Development
Major new features planned for version 11.1 include:
- New *K* solution for through crack in web of T-section
- New *K* solution for surface crack at fillet of L-section
- New *K* solution for corner crack at L-section
- New *K* solution for edge crack growing toward hole
- Elastic-plastic fracture mechanics (EPFM) module improvements
- Capability to use API 579 & ASME Paris equations
- Access to material database from critical crack size module

Plans for future versions include:
- Superposition methods for time-dependent crack growth
- Advanced methods for thermomechanical fatigue crack growth
- Approximate (compounding) method for multi-site damage
- Ability to call NASGRO directly from another user program
- More improvements to EPFM module and documentation
- Additional *K* solutions for other unique geometries
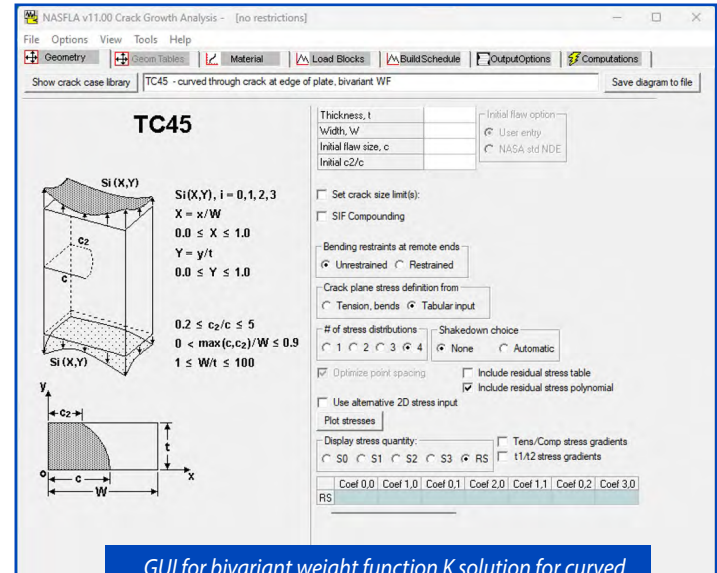
GUI for bivariant weight function K solution for curved through crack at edge of plate

$$\frac{da}{dN} = C\left[\left(\frac{1-f}{1-R}\right)\Delta K\right]^{n} \frac{\left(1 - \dfrac{\Delta K_{th}}{\Delta K}\right)^{p}}{\left(1 - \dfrac{K_{max}}{K_{c}}\right)^{q}}$$

NASGRO fatigue crack growth equation
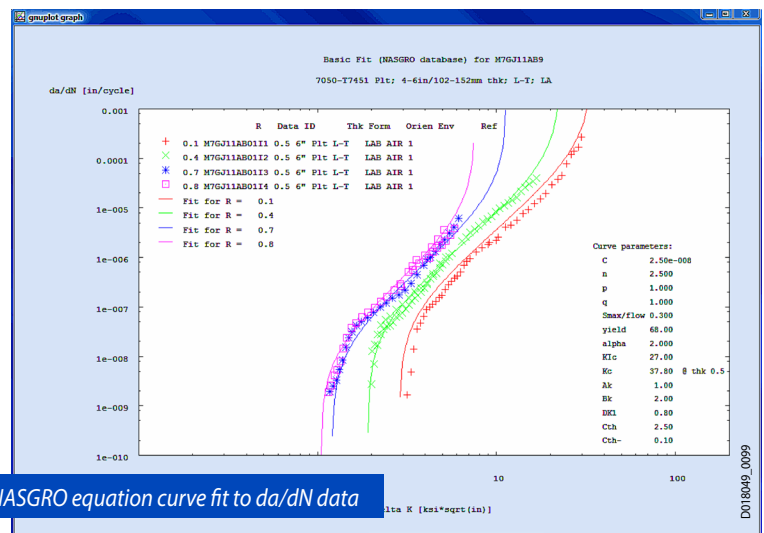
NASGRO equation curve fit to da/dN data

Crack Growth Module

- Over 110 different K solutions
  - Uniform tension/bend/pressure/pin load
  - Univariant/bivariant weight function models
  - User-defined tables
  - Generalized compounding
- Multiple crack growth rate models
  - NASGRO, Walker
  - Tabular da/dN vs. ΔK data
  - Temperature effects
- Multiple load interaction models
- Multiple load history input formats
- Load spectrum visualization, editing, cycle counting
- Multiple analysis options
  - Calculate K, life, da/dN
  - Critical initial, final, or threshold crack size
- Account for residual stresses
- Cyclic shakedown for local plasticity
- Elastic-plastic crack growth analysis
- Failure assessment diagrams
- Interactive and batch modes

Material Property Module

- Search, retrieve, plot, and curve fit data
- Import user data
- English or metric units
- Over 500 metallic materials
- 3,600 sets of FCG data
- 6,500 fracture toughness points

CC17
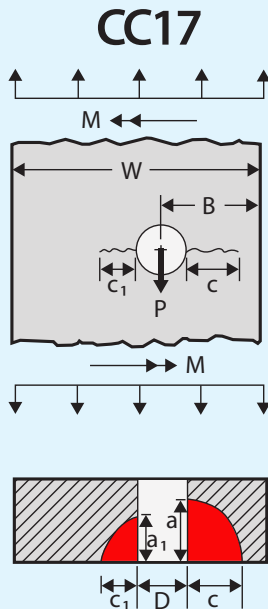
K solution for two unequal corner cracks at offset hole in a plate.

The NASGRO software runs on all Windows platforms. User support and training courses are available. A perpetual license for a single copy of version 11.0 is $4,900. Organizations with multiple users should consider a site license or participation in the NASGRO Consortium. Special prices may apply for non-US companies, especially in China and India. Please contact SwRI for a specific quote.

SC34
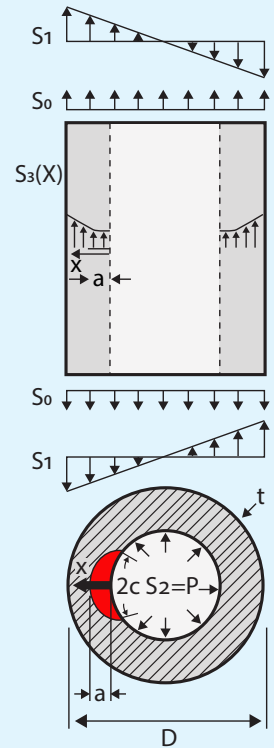
Univariant weight function K solution for a surface crack in a hollow cylinder

NASGRO Consortium Participants

The Aerospace Corporation
Airbus
Airbus Canada
BAE Systems
Blue Origin
Boeing
Bombardier
Embraer
GKN Aerospace
Honda Aircraft Engines
Honeywell
IHI Corporation
Israel Aerospace Industries
Korea Aerospace Industries
Leonardo
Lockheed Martin Aeronautics
Mitsubishi Heavy Industries
RTX
Siemens Energy
Sierra Nevada Corporation
Sierra Space
Sikorsky
SpaceX
Spirit AeroSystems
United Launch Alliance

For additional information, please contact:

Joseph W. Cardinal, P.E.
Program Director
Structural Engineering
210.522.3323
joseph.cardinal@swri.org

Mechanical Engineering Division

James C. Sobotka, Ph.D., PMP
Lead Engineer
Materials Engineering
210.522.6417
james.sobotka@swri.org

nasgro.swri.org