SOUTHWEST RESEARCH INSTITUTE

NASGRO®

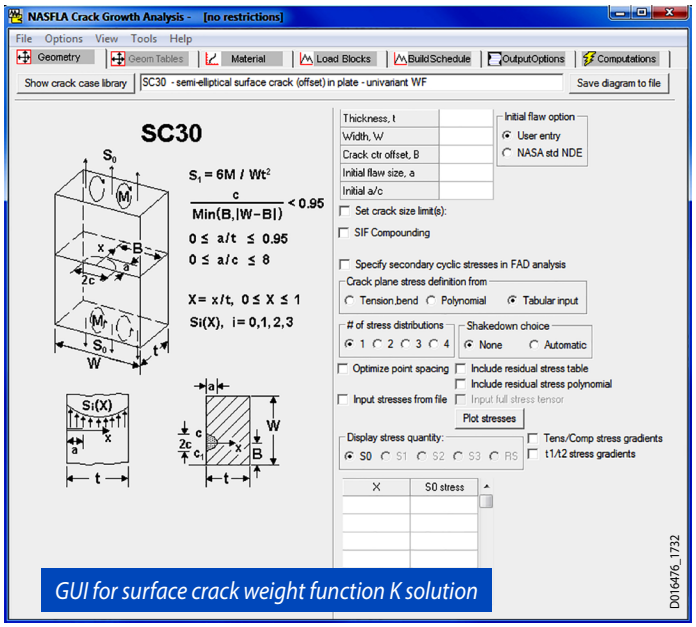
Fracture Mechanics & Fatigue Crack Growth Analysis Software

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.



GUI for surface crack weight function K solution

Recent Enhancements

Recent enhancements in the current version 10.2 include:

- New *K* solution for curved through cracks at every hole in row of holes
- New *K* solution for one corner crack at single hole in row of holes
- New weight function (WF) *K* solution for curved through crack at edge of plate
- New WF *K* solution for internal circumferential surface crack in a cylinder
- New *K* solution for circumferential through crack in finite-length thin cylinder
- New *K* solution for semi-elliptical surface crack in notched round bar
- New API 579 *K* solution for corner crack at pressure vessel nozzle
- New bivariant WF *K* solution for corner crack at pressure vessel nozzle
- New multi-temperature capabilities for shakedown and FAD calculations

Future Development

Major new features planned for version 11.0 include:

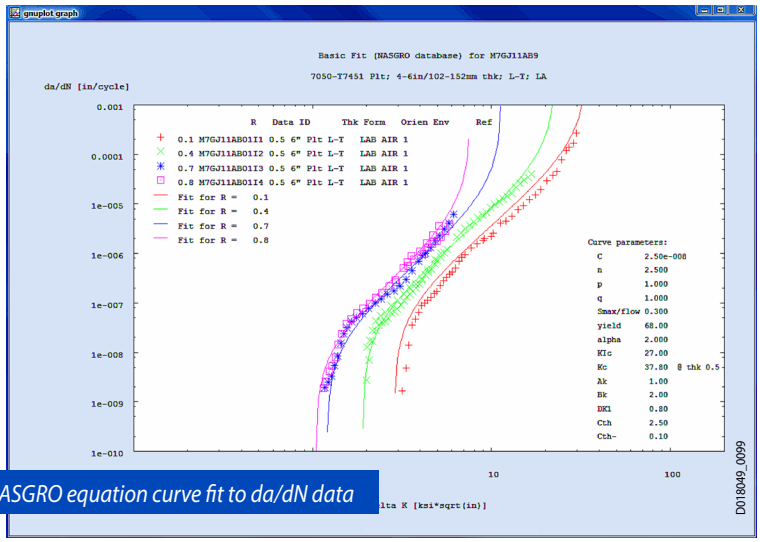
- New bivariant WF *K* solution for curved through crack at edge of plate
- New *K* solution for two curved through cracks at one hole in row of holes
- New bivariant WF *K* solution for corner crack on long ligament side of hole
- New *K* solution for corner crack in T-section flange
- Expansion and update of EPFM models and capabilities
- API 579 crack transition criteria and weld residual stress polynomials

Plans for future versions include:

- New *K* solutions for surface or corner crack at fillet of L-section or T-section
- Superposition methods for time-dependent crack growth
- Advanced methods for thermomechanical fatigue crack growth
- Additional *K* solutions for curved through cracks
- New *K* solutions for plates and lugs with out-of-plane bending from pin loads
- Additional *K* solutions for other unique geometries

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

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

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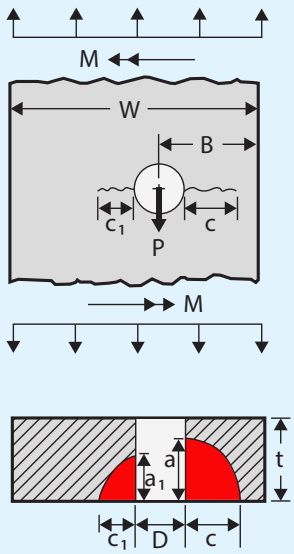

K solution for two unequal corner cracks at offset hole in a plate.

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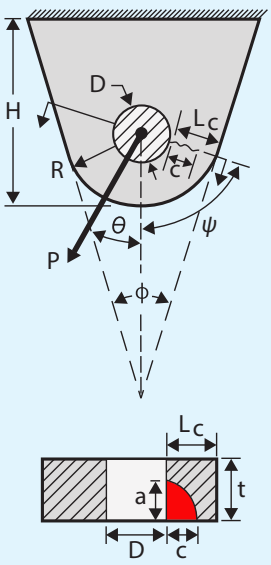

K solution for a corner crack in a tapered lug with an oblique load

The NASGRO software runs on all Windows platforms. User support and training courses are available. A perpetual license for a single copy of version 10.2 is $4,400. 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.

NASGRO Consortium Participants

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