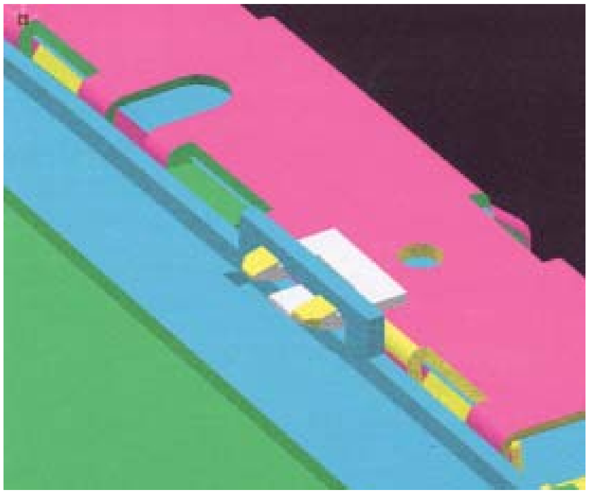
Avoidance of Tabs Failure

Finite Element Analysis (FEA) has, over the past two decades, rapidly become the most popular technique for the computer solution of engineering problems. In structural mechanics, the method breaks the solution domain into elements, interconnected by nodes, over which are imposed forces, moments, translations, and rotations.

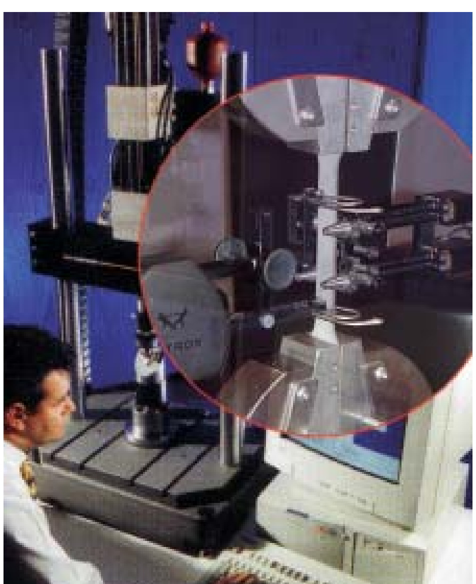


Tool Casing Tab

A mathematical formulation releases nodal degrees of freedom, resulting in a large set of simultaneous equations, suited for computer solution. For structural problems, the implementation of loads and boundary conditions, leads, after calculations, to displacements, rotations, reaction forces and moments. Substituting such values back at the element level provides distribution of strains, and stresses (using constitutive equations, like Hook's law in elasticity) within the entire domain.

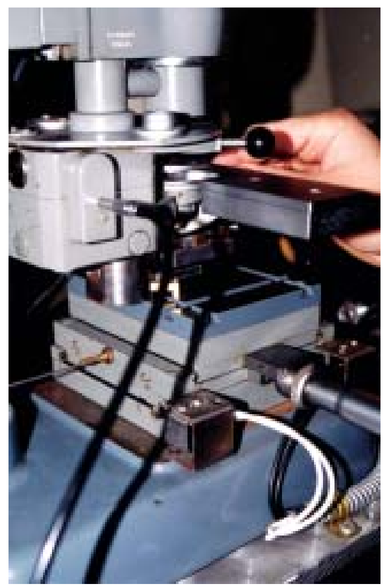
Accurate prediction of displacement fields using FEA requires proper modeling to: (1) Geometry, (2) Materials properties, (3) Boundary conditions, and (3) Loads. Still, modeling can be simplified to two-dimensions, under planar conditions: plane strain, plane stress, or axial symmetry. Alternatively, many structures present cyclic symmetry, and a "piece of pie" is cut for analysis. Modeling can also be simplified if 1/ expected deformations and strains are small, 2/ materials behave elastically, and 3/ boundary conditions are limited to the restraints-type.

Unfortunately, modeling tab assemblies (common, in many industrial applications), for example, involves large deformations, and sliding, which makes the analysis nonlinear.



True Stress-Strain Testing Plastics

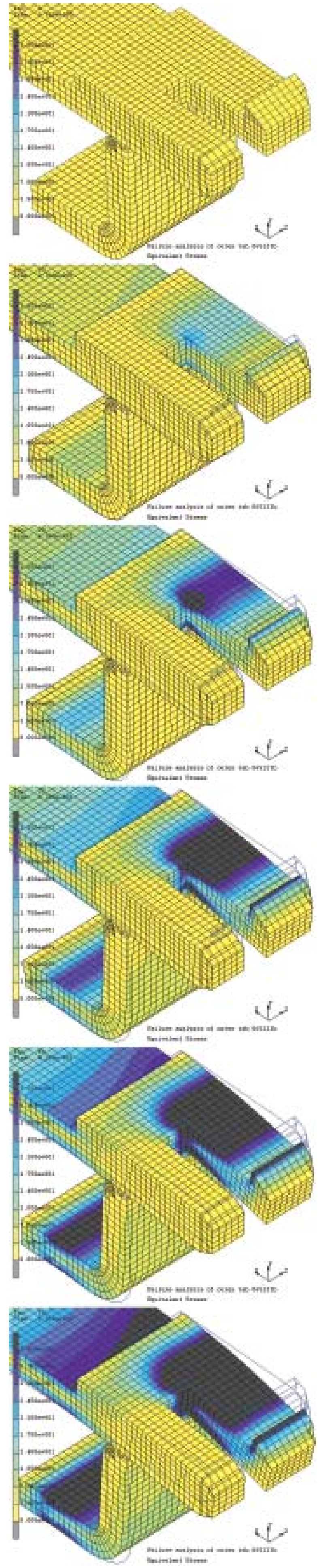
To simulate breaking tabs for *Sur-Flo*, on behalf of *Lear Corp.*, plastics were characterized to failure, at WIDL, under true stress-strain conditions. Testing looked into anisotropy (resulting from fibers orientation), and creep with time and temperature.



Dual Materials Friction Testing

Modeling tabs for *Sur-Flo* started in the linear régime at WIDL. Nonlinear analyses then followed tab assemblies in tiny displacements (reaching the thousands, for smooth displacement-reaction curves), with each iteration requiring the passage by the solution routine (making the analysis quite long).

Post-processing nonlinear analyses looked at strains and stresses on deformed tab geometries. Failure was associated to von Mises equivalent stress reaching the tensile strength of the fiber-reinforced plastics, used in the study. Modeling also looked into tabs retention in time, with dimensional variations. Combination of virtual and real-life testing at WIDL generated useful data for *Sur-Flo* and *Lear*.



Tab-Housing Assembly