

Viscoplastic Ring MTS

0.1 Objective

This problem exercises the plasticity algorithm on an axisymmetric multi-material problem.

0.2 Definition

A ring of viscoplastic material surrounds a plug of elastic material. The problem is started with both materials well below their stress-free reference temperature. The initial stress state results in plastic flow of the ring, primarily near the interface between the two materials. The assembly is also allowed to cool using convection boundary conditions on the external surfaces.

0.3 Metrics

As described below, there is no analytical solution for comparison. The temperature and solid mechanics variables are compared to a previous solution. It is desirable to specify different convergence tolerances for different variables. It may also be useful to transform the results to cylindrical coordinates and check for axisymmetry with a very loose tolerance.

0.4 Truchas Model

This problem is run on a rather coarse quarter symmetry mesh. In addition to the symmetry BCs, the bottom surface is constrained from moving normal to the surface. Convective thermal BCs are defined on the top, bottom and outer radius. As currently specified, there is no analytical solution for this problem. There is a significant amount of discretization error because of the coarse unstructured mesh, so the solution is only axisymmetric within a few tenths of a percent. The viscoplastic properties will be taken for a real material fit to the mechanical threshold stress (MTS) model.

0.5 Results

The “golden” solution for comparison will be analyzed for consistency and reasonable behavior.

0.6 Critique