2D AXISYMMETRIC JOULE HEATING (EM3)

1. Test Objective

This test problem exercises the Joule heating model in a more complicated setting than EM1. The hex and tet meshes are not conforming and thus truly exercises the grid-to-grid mapping, and the induction coil source capability is exercised as well.

2. Problem Description

An electrically-conductive ball is centered within a 2-turn induction coil. The induced EM fields, current, Joule heat, and temperature fields are all 2D, depending on the radial distance from the axis of the coil/ball and the distance along the axis, but not on the azimuthal angle.

3. Truchas Model

The problem domain consists of a coaxial cylinder, contained within the coil, that includes the conducting ball and some of the surrounding free space. Problem symmetry is exploited by solving only in the positive octant. Appropriate symmetry conditions are imposed on the symmetry planes. The hex mesh used for heat conduction meshes only the ball, and the tet mesh is independent of the hex mesh and is not conforming.

Heat conduction is modeled using constant properties throughout the ball, with no flux conditions on the symmetry planes, and on the surface of the ball.

The characteristics of the magnetic source field are constant throughout the simulation and only a single Joule heat should be computed.

4. Test Metrics

For this problem we simply want to verify that the computed Joule heat has the expected value, which we will do by comparing the step 0 result against a reference result using a maximum relative error norm.

As an additional check we compare the temperature at the final output with reference temperature results, also using a maximum relative error criterion.

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