Quality assurance (QA) of three-dimensional (3-D) radiation treatment planning systems (RTPS) and CT-simulators (CT-sim) is necessary for ensuring that they fulfill their potential. Currently, comprehensive tools for their QA, especially as related to nondosimetric parameters, have not been developed. We present a phantom that facilitates the evaluation of many non-dosimetric parameters, including the display of 3-D radiation beams, multiplanar CT image reconstructions, digitally reconstructed radiographs, the manipulation of contoured patient anatomy, dose volume histograms, and the conversion of CT numbers to relative electron densities. The phantom contains geometries and inhomogeneities that are appropriate for the QA of the features described above. One component of the phantom can be used to verify beam and image displays for 3-D orientations. A second component contains volumes of interest that test the software's ability to manipulate anatomical structures. Three commercial 3-D RTPSs and a CT-sim have been evaluated with the phantom. The use of this phantom demonstrated the existence of errors and limitations in the display capabilities and planning tools in the systems evaluated. Some of these problems have the potential to lead to errors in radiation treatment. In addition, differences in the implementation of planning tools from system to system were notable. In summary, this phantom is a unique tool designed explicitly for the QA of 3-D radiation treatment planning procedures. We have demonstrated that QA of 3-D RTPSs and CT-sims is necessary, and that this phantom is an effective tool for the task.