

MINIATURIZATION OF X-RAY STRESS ANALYZER

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There are many mechanical parts whose reliability heavily depends on their residual stresses. It is also true that most of these parts cannot be measured for residual stress because of the size limitations. Therefore, the miniaturization of an X-ray stress analyzer is one important subject in this field. Various efforts have been made, however, the current minimum size of an analyzer seems to be determined mainly by the miniaturization of the X-ray tube and the detector. Little discussion has been held on the size of the X-ray path from X-ray focus to detector through the collimator and specimen.

In this paper, the problems caused by the miniaturization of the goniometer are discussed from the view point of the stress measurement error caused by mis-setting the specimen and misalignments of the collimator and detector. The stress measurement errors were calculated using a model and a simulation method presented by the authors.

As a conclusion, the combination of a goniometer of 30 mm in radius and collimator of 0.5 mm in width and 30 mm in effective length is proposed for the iso-inclination assembly X-ray stress analyzer using a position sensitive detector, if the total error of 40 MPa is acceptable.

The single exposure method at 45 deg in incident angle was also investigated. Large stress errors due to the misalignment of collimator and detector can occur, but the experimental errors are found extremely small. Therefore, the single exposure method has possibility to miniaturize its size, if the advanced technique in components assembly could be adapted.

