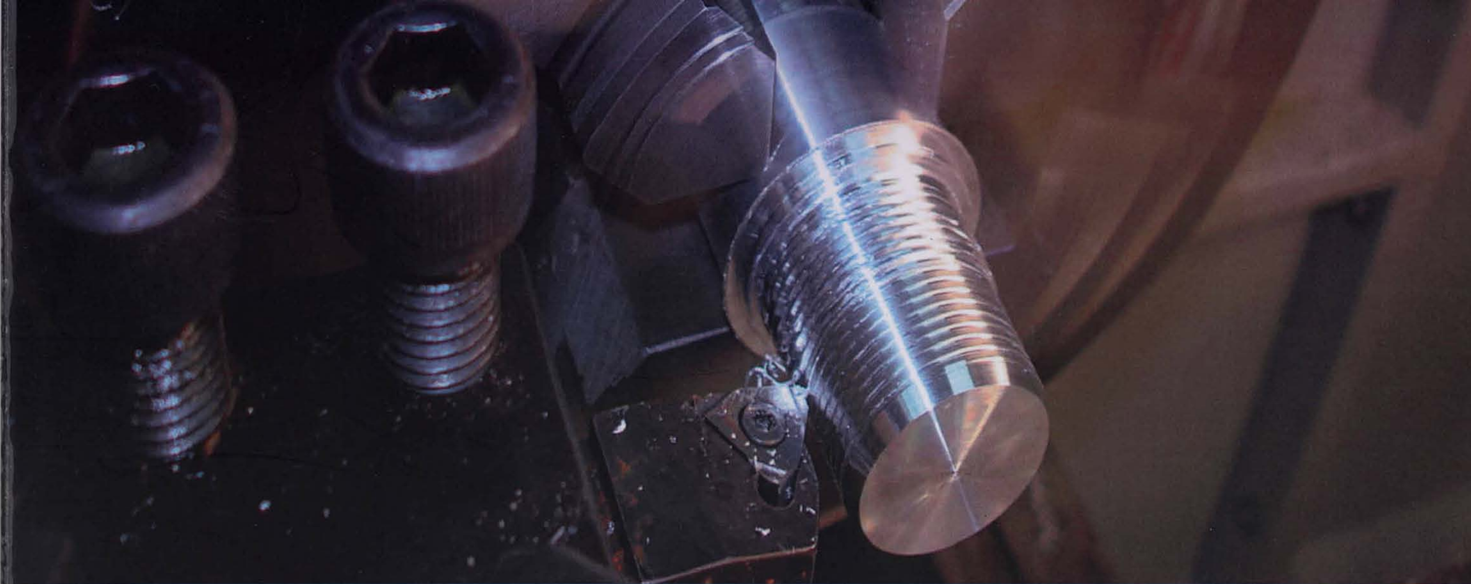

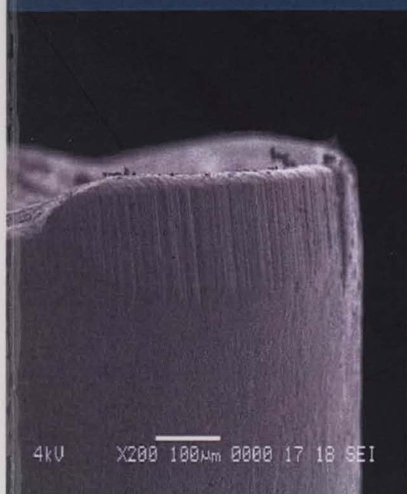

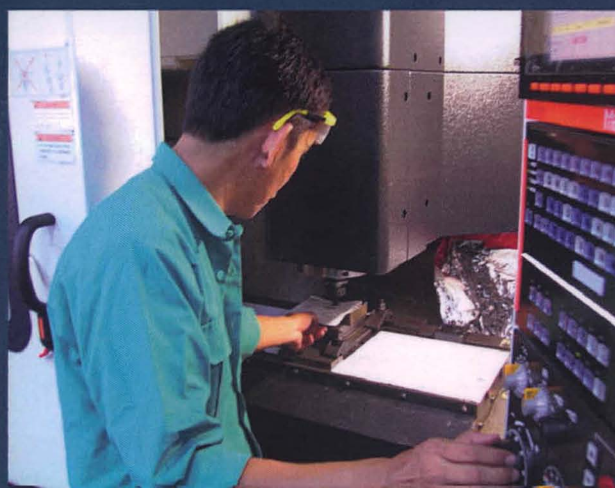

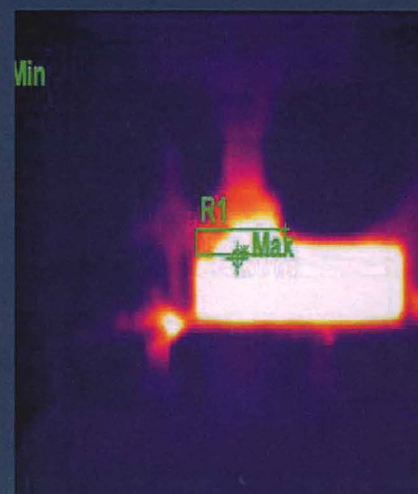

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Towards Improved Manufacturability

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Chapter 23

Numerical Analysis to Characterize Triaxiality Value of Adhesive Joint due to Particular Load Configuration. Part 1: Butt Joint

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1. Triaxiality of Adhesive Joints

Structural engineer in general considers that a uniaxial tensile test is suitable to describe the behaviour in structures. But, in a multi-axial loading state, this understanding needs to be updated. Scaffer et al.[1] stated that the void nucleation, void growth, and void coalescence models depend on the triaxiality. If the triaxiality value rised, tendency to failure increased. He also stated that a proper calculation of the triaxiality needs 3D non-linear analysis.

A unique behaviour of triaxiality is that it can be controlled by adjusting the geometry or loading mode. Barsoum[2] had performed research where triaxiality was controlled and kept constant during the test by maintained the ratio between tension and torsion fixed. Decreasing the torsion will also decrease the triaxiality and vice versa. Seppala et al.[3] explained that void growth occurs because system tries to relax from an applied tension load in order to minimize the elastic energy. Material around the void will deform plastically to accommodate the void growth. Naturally, a plastic deformation emerges because of local shear stress that might occur from an applied load or from a stress field around the void, even if it is a hydrostatic stress.

Dutta and Kushwaha[4] found that a stress state is an important factor in a crack initiation and the strain failure. The stress state generally can be presented by the stress triaxiality, which has a very important role in ductile failure. Higher triaxiality value show how dominate a hydrostatic stress in stress field. On the contrary, a stress deviatoric component has important role compared to the hydrostatic stress at low triaxiality values. Void growth rate related directly to the stress triaxiality value and plastic strain accumulation. Scahfer et al[1] has performed a non-linear finite element analysis of a round bar with a notch, which was subjected to a small-scale tension load.