SUMMARY

The application of the autofrettage principle to materials of 165,000 psi yield strength has been experimentally investigated. Resulting from this investigation are a series of relationships for the stresses and displacements in overstrained thick-wall cylinders in the open-end condition. These relationships, which can be used for pressure vessel design purposes, are based on the von Mises yield criterion but incorporating empirical constants for simplicity. The agreement between these relationships and the experimental data is good.

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BRITTLE FRACTURE IN LOW CARBON S[illegible] UNDER TENSILE AND TORSION TEST

TAKEO YOKOBORI* and AKIO OTSUKA†

*Professor, Department of Mechanical Engineering, Tohoku University, Sendai, Japan.
†Lecturer, Department of Shipbuilding, Hiroshima Univer[illegible] Hiroshima, Japan.

Abstract—To elucidate the mechani[illegible]ittle fractu[illegible]ld steel, the stress condition and the related phenomena [illegible] fracture [illegible]. The experiments were conducted at liquid nitrogen [illegible]ure on soft[illegible]-walled hollow cylindrical specimens with test portio[illegible] same shap[illegible]ensile and torsion tests, of an identical low-carbon steel [illegible] a considerable ra[illegible] of grain size, that is, ranging from ASTMGS No. 1.4 to AST[illegible]GS No. 5.5.

The following c[illegible]eristics and conclusions were obtained:

(1) In the te[illegible] macroscopic fracture produced both spiral [illegible] an axial fracture s[illegible] The propagation direction of the spiral fracture su[illegible]e makes about 45° [illegible] with the specimen axis.

(2) The spiral part of the fracture surface appears to occur earlier than the axial part of the fracture surface in torsion fracture.

(3) Using the split technique, the fracture surfaces of both spiral part and axial part in torsion fracture were found to be of the cleavage type.

(4) The plastic deformation prior to cle[illegible]ge fracture is greater in the torsion test than in the tension test.

(5) In the torsion fracture test, very [illegible] dependence is found of fracture stress on ferrite grain size.

(6) The ratio τ_{fl}/σ_{fl} of torsional fractu[illegible]ress τ_{fl} to tensile fracture stress σ_{fl} increases considerably with increase of ferrite grain size, for example, varying from 0.55 to 0.82 corresponding to the variation of the grain size from ASTMGS No. 5.5 to ASTMGS No. 1.4.

(7) At liquid nitrogen temperature, the ratio τ_{yl}/σ_{yl} of torsional yield stress τ_{yl} to tensile yield stress σ_{yl} increases considerably with the increase of ferrite grain size, for example, varying from 0.50 to 0.63 corresponding to the variation of the grain size from ASTMGS No. 5.5 to ASTMGS No. 1.4.

(8) The stress criterion for brittle cleavage fracture in low carbon steel does not obey the maximum tensile stress law, nor the maximum shear stress law, nor the von Mises criterion nor the modified von Mises criterion by Peterson. The tensile stress component and the shear stress component of applied stress should be involved at the same time in brittle fracture. In this respect, the Cottrell theory of brittle fracture is most favorable.

The possibilities of the interpretation of the results mentioned from (1) to (8) in terms of the Cottrell's theory of brittle fracture in mild steel or in terms of another mechanism suggested are discussed.