9th German-Greek-Polish Symposium
Recent Advances in Mechanics
September 04-09, 2016
Kolympari, Chania, GREECE

ON THE EXPERIMENTAL TECHNIQUES FOR THIN SHEETS TESTING AT LARGE DEFORMATIONS

Prof. Z.L. Kowalewski[1], **Prof. L. Dietrich**[1], **Prof. G. Socha**[2]
[1]Institute of Fundamental Technological Research, Poland
[2]Institute of Aviation, Poland

Abstract: *Problems associated with material testing on flat specimens under large deformation due to compression or cyclic tension-compression are discussed. A short review of the anti-buckling fixtures developed up to now is given with special emphasis on the new fixture elaborated at the Institute of Fundamental Technological Research in Poland.*

1. Introduction

Material characterization using flat specimens under compression within large deformation range procure many difficulties. The buckling effect is regarded as the most significant. Among many important phenomena observed during cyclic tests carried out on the flat specimens one can distinguish: (a) changes of the hardening modulus of a material due to variation of the loading direction; (b) strain-hardening stagnation observed after change of the loading direction; (c) relationship between strain amplitude and stress saturation; (d) changes of the elastic modules due to cyclic loading. Tension-compression tests are especially important for materials exhibiting mechanical properties to be dependent on the first stress invariant. One can indicate the magnesium alloys for example.

The fixture elaborated by the team from IPPT changes its length with specimen elongation or shrinkage during a test which allows application of cyclic load, Fig. 1. The friction force, which is generated due to a movement of both parts of the fixture, is measured by the special strain gauge system during each test. It allows eliminating friction force influence on the stress-strain characteristics.

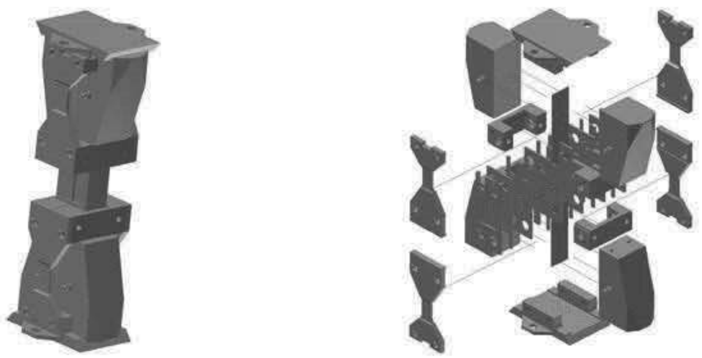

FIGURE 1: Scheme of general and exploded views of the fixture

The results of investigations carried out on steel, brass and aluminium alloy using the new fixture were captured. Selected examples are presented in Fig. 2 for the brass. It shows the results from strain controlled tension-compression cycles performed for the constant strain amplitude equal to ±2%, Fig. 2a, and variable strain amplitude within the range ±4%, Fig. 2b. Variations of the strain control signal are presented for both tests in graphs (c) and (d) of Fig. 2, respectively. Force responses into those programmes together with friction force measurements are documented in graphs (e) and (f) of Fig. 2. As it is clearly shown, the brass exhibits softening effect. Also, the so called strain-hardening stagnation observed after change of the loading direction may be noticed.

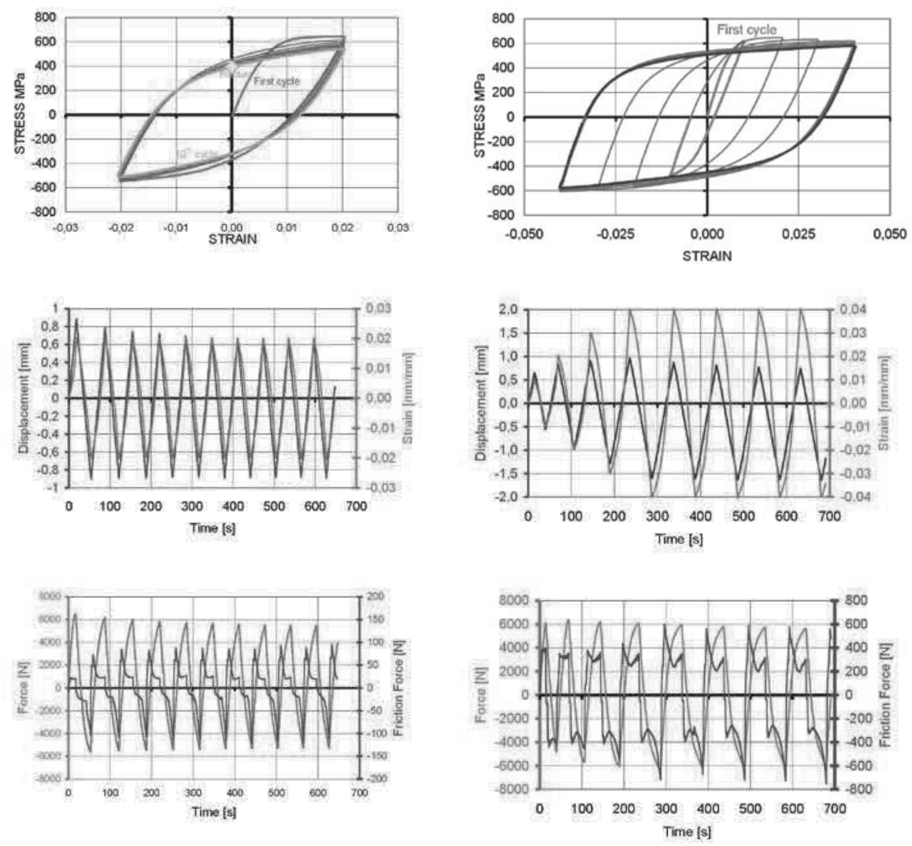

FIGURE 2: Hysteresis loops under cyclic tension-compression for: (a) constant; and (b) variable strain amplitude; graphs (c) and (d) represent strain control signal and displacement; graphs (e) and (f) show force responses into the strain control signals in graphs (c) and (d), respectively

2. References

[1] Dietrich L., et al., Anti-buckling fixture for large deformation tension-compression cyclic loading of thin metal sheets, *Strain Int. J. Exp. Mech*., **50**, 2014, pp. 174-183.