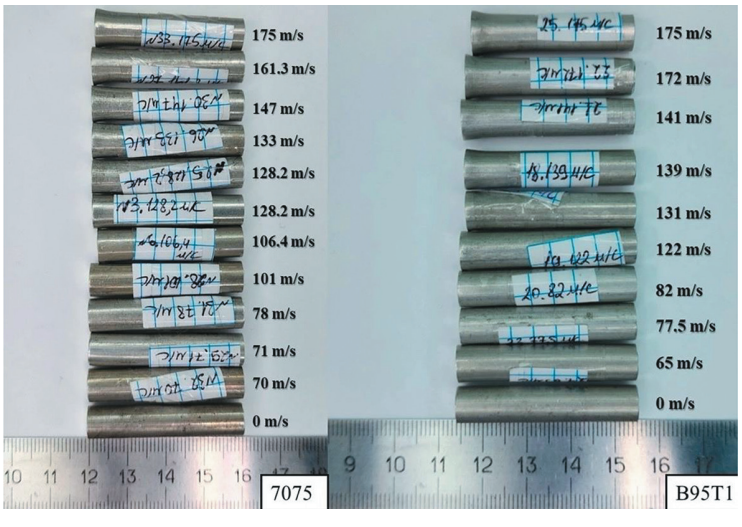
DYNAMIC PLASTICITY AND FRACTURE OF Al 7075 AND V95T1 ALLOYS

A. Ya. Cherepanov, E. S. Rodionov, A. G. Fazlitdinova, T. T. Sultanov, V. G. Lupanov, P. N. Mayer, A. E. Mayer

Chelyabinsk State University, Chelyabinsk, Russia

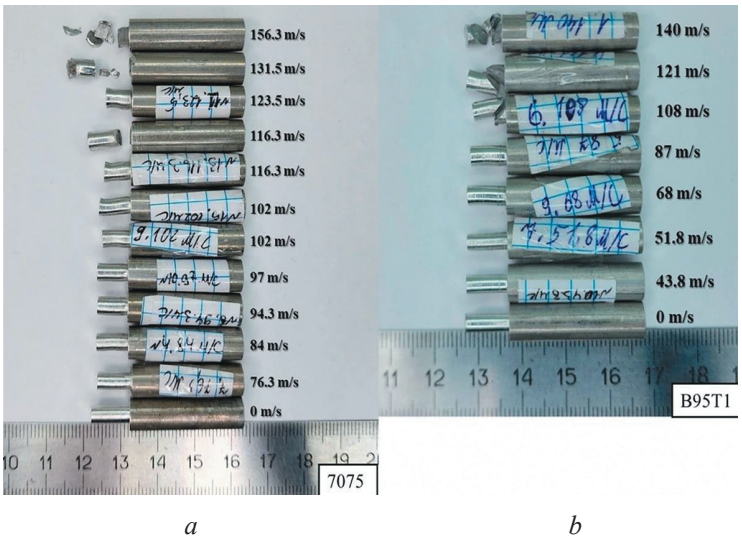
Despite the significant development of theoretical models and numerical simulations in the field of solid mechanics, conducting full-scale material deformation experiments will remain a relevant task for a long time. A full-scale experiment allows studying the mechanical response of a material under quasi-static or dynamic loading, which is of great importance for industrial applications. Dynamic loading is widely used in industrial manufacturing processes such as high-speed machining and thermomechanical processing, as well as in service conditions, especially in the aerospace, transportation and defense fields. One of the popular experimental methods for dynamic material loading is the Taylor test [1].

A new [2] method for measuring the dynamic yield strength and the corresponding strain rates is proposed, obtained as a result of experiments using cylindrical specimens with a truncated head. The method was



a *b*

Fig. 1. Photographs of classic cylindrical samples after dynamic tests:
a – Al7075 alloy; *b* – V95T1 alloy



a *b*

Fig. 2. Photographs of profiled samples after dynamic tests:
a – Al7075 alloy; *b* – V95T1 alloy

applied to study the dynamic properties of aluminum alloys 7075 of Chinese manufacture and its Russian analogue V95T1. In the experiments, cylindrical specimens of the following shapes were used: a classic homogeneous cylinder with a diameter of 8 mm, a length of 40 mm and a profiled cylinder of the same total length, but with a reduced head with a diameter of 4 mm and a length of 10 mm. The measured dynamic stress flows were tested using the classic Taylor method and compared with the literature data. The work shows that the dynamic yield strength of the 7075 alloy is 786 MPa, at strain rates of $(4–8) \cdot 10^3$ s^{-1}, which is 25% higher than the value of 624 MPa for the V95T1 alloy at strain rates of $(2–6) \cdot 10^3$ s^{-1}. The threshold impact velocity causing head failure of 4 mm diameter specimens is 116–130 m/s for 7075 alloy and only 108 m/s for V95T1 alloy. On the other hand, the compressive failure strain of V95T1 alloy, which is 0.29–0.36, is approximately 8% higher than the compressive failure strain of 7075 alloy, which is 0.27–0.33. V95T1 aluminum alloy has lower strength but is more ductile, while 7075 aluminum alloy has higher strength but is more brittle.

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References

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