A method is proposed of evaluating the endurance of the material and its thermal and stress states in the vicinity of wedge-shaped zones of engine components on the basis of the results of testing wedge-shaped models whose faces are subjected to the effect of a gas flow in the direction normal to the axis of the wedge and the edges are insulated. The results are presented of an accurate analytical solution of temperature and stress fields in the cross section of the wedge-shaped model during the cyclic variation of the temperature of the medium and arbitrary duration of half cycles of heating and cooling. The calculation results are compared with the results obtained in thermometric examination. It is shown that it is possible to specify accurately and unambiguously and determine the temperature and stresses in the vicinity of wedge-shaped zones of models in a wide range of variation of the parameters of thermal-stress state of the material corresponding to the range of states of the material during service of engine components. The proposed test method reduces the consumption of gas and increases the temperature and stresses on the faces with a relatively large radius of curvature and a short length of the wedge. The gas has almost no effect on the components of the testing chamber.

The fact that the thermal and stress state of the material in the vicinity of wedge-shaped zones of engine components has not been accurately determined greatly complicates the prediction of their service life. A maximum error is detected in the vicinity of these zones in measuring temperatures as a result of steep gradients of the parameters of the state of the material in the cross section, high rates of temperature variation, and also the effect of products of combustion of fuel on temperature gauges.

The calculation methods used for evaluating the thermal and thermal-stress states of the material are also characterized by a large error since the distribution of the heat exchange coefficients in the vicinity of wedge-shaped faces, for example, blades of gas turbines or combustion chambers of pistons of internal combustion engines, have not been accurately determined. In addition to this, the conditions of stability and convergence of the numerical calculation methods in the vicinity of the wedge-shaped zones are unsatisfactory.

These special features of operation of the material in the vicinity of the wedge-shaped zones of engine elements reduce the accuracy of both calculation and experimental methods of evaluating their service life, including final stand tests on full-size elements since the parameters of the state of the material of full-sized elements in their stand tests differ from the parameters in service of the elements.

Methods were developed previously for examining the thermal fatigue of materials using models with wedge-shaped zones which were not geometrically similar to the full-size elements [1-3]. These models yield thermal fatigue characteristics in a wide range of the states of the material of the wedge-shaped zones of engine components typical of service. Identical states of the material can be formed in the examined models and structural members in service.

However, the complicated evaluation of the thermal and stress states of the material of the wedge-shaped zones reduces the accuracy of these methods of predicting the service life of engine components. Examination of the thermal and thermal-stress states of wedge-shaped models with a gas flow blown against the wedge showed [2] that the distribution of the heat exchange coefficients on the surface of the wedge is hardly nonuniform. As indicated by Fig. 1, the heat exchange coefficients differ by two orders of magnitude and the maximum values are obtained in the vicinity of the wedge-shaped faces (curve 1). Consequently, the
values of temperatures and, consequently, stresses in the vicinity of the faces (curve 2) are highly indetermined.

A method was proposed in [4] of testing wedge-shaped models which increases the accuracy of determining the thermal and stress states of the material of the wedge-shaped zones of test specimens and can also be used to evaluate the error of experimental and calculation methods of determining temperature and stress fields in the vicinity of the wedge-shaped zones of engine components by comparing the data on the states of the material of the same models obtained by accurate and approximate methods.

In the method, wedge-shaped models are placed with their faces against each other and the gas flow is directed in the direction normal to the faces and the axis of symmetry of the wedge into the gap between them. The remaining part of the wedge-shaped models, with the exception of the face on which the gas is blown, is insulated with materials with low

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Fig. 1. Distribution of heat exchange coefficients $\alpha$ (1, 3) and temperature $T$ (2, 4) along length of wedge $l$ in blowing a gas flow against the wedge (solid line) and in thermal insulation of the edges of the wedge (broken lines). (Dot hyphen and hyphen dash lines indicate dependences determined with high methodical errors).

Fig. 2. Diagram showing the position of wedge-shaped models in the testing chamber: 1) combustion chamber; 2) turbolyzer for equalizing temperature in the cross section of the gas flow; 3) seals; 4) specimens; 5) calculated reduction of gas temperature as a result of heat exchange with specimens; 6) results of thermometric examination (reduction of temperature is slightly smaller as a result of processes of final combustion of fuel in the testing chamber).