Stability limits for methane–air flames under the external acoustic and gravity impact

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Recently, methane has become an important fuel for power plants. This is due to the advantages of methane as a fuel: low cost, relatively high density, environmental safety, proven storage technologies, etc. However, the creation of stably functioning methane engines requires solving a number of fundamental problems associated with a narrow concentration range of ignition, as well as a low methane–air reaction rate. During the real aircraft operation, external effects affect the flame, such as gravity (due to maneuvering), acoustic effects that can provoke its destabilization and blow-off or flash-back, which can leads, to severe consequences, up to the engine and aircraft destruction. Lean flames stabilization can be implemented using stabilizing bodies that promote vortex flows formation. In the vortex flows region, the velocity decreases, which makes it more sensitive to the mass forces effect (in the case of subsonic flows). Similarly, acoustic disturbances affect the vortex flow nature, and can also, due to positive feedback, influence the flame front oscillations dynamics. Accordingly, the study of such combined effects is of great current interest. The work is devoted to methane–air flames stability study, stabilized by the central body, under the external acoustic field, and different gravity conditions. It is shown that for laminar flames stability both the effect of acoustic field and gravity one is noticeable.

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