Serpentine-type are widely used in aviation equipment and various industries—chemical, oil and gas, nuclear etc. Heat-exchange surface at that equipment is designed as flat or volumetric serpentine. Heat-transfer agent is supplied with high pressure into intertubular space. Current paper is devoted to heat exchanger design development with special requirements to thermal and stress conditions, as well as 3D-modelling of liquid flow and heat exchange processes. Conjugated heat transfer problem is modelled. In the intertubular space the turbulent flow of viscid gas with varying thermophysical properties is considered; in the tube space heat-transfer agent flow with temperature-dependent transport and thermophysical properties is considered; in the solid medium heat transfer equation with temperature-dependent heat conductivity coefficient is solved. Unsteady flow features and heat exchange features in the tube space and intertubular space are presented. Thermal transport in the solid metal body of serpent-type tubes is depicted, as well as its effect on the flow pattern. For current heat-exchanger configuration some flow regimes that provide efficient usage of heat exchanger has been determined.