

# Hardware and software complex for registration of parameters of flame erosion processes of liquid-propellant rocket engines heat-stressed structural elements



## Hardware and software complex

1. Digital PTZ video camera. 2. Measuring complex. 3. Alternating electric field measurement antenna. 4. Alternating magnetic field measurement antenna. 5. Power supply unit for electric field sensor. 6. Signal conditioning unit for magnetic field sensor. 7. Channel splitter. 8. Alternating electric field sensor. 9. Alternating magnetic field induction sensor. 10. Antenna power supply. 11. Telescope. 12. Optical radiation spectrometer, 3. Vibration sensor amplifier. 14. Microphone. 15. 16, 17. Optical adapters. 18. Vibrosensor. 19. Microphone power supply. 20. Thermocouple switching module. 21. Thermocouples. 22. Power supply for pyrometer. 23. Pyrometer. 24. Instrument rack. 25. Video camera electronic module. 26. Notebook computer. 27. Printer. 28. Double-axis positioning platform. 29. USB splitter. 30. Tripod. 31. RS485-USB interface converter.

## Purpose

Hardware and software complex is designed for investigation of flame erosion processes of heat-stressed structural elements of liquid-propellant rocket engines by using non-contact electromagnetic, optical, thermal and other monitoring methods and means.

## Capabilities

Hardware and software complex provides registration and processing of:

- Magnitudes of alternating magnetic field strength vector components;
- Alternating electric field strength;
- Optical radiation spectra of liquid-propellant rocket engine plume in order to identify chemical elements entering engine plume as a consequence of flame erosion processes of liquid-propellant rocket engine's structural elements;

- Thermal field parameters;
- Video data of fire test process;
- Operating parameters (flow-rates, pressures, temperatures...);
- Vibration and acoustical oscillations.

Hardware and software complex provides investigation of:

- electromagnetic fields origination and amplitude-frequency characteristics of electromagnetic fields and optical radiation of high-temperature gas flows during stand fire tests of liquid-propellant rocket engines,
- influence of main operating parameters of liquid-propellant rocket engine work on electromagnetic parameters of high-temperature gas flows,
- processes of entering of material particles and condensed phase into the gas path of liquid-propellant rocket engine,
- processes of erosion of liquid-propellant rocket engine flow channel.

### **Range of applications**

Engine-building, machinery manufacturing, energy industry, aviation, astronautics, robotics. Systems for automatic monitoring, investigation, diagnostics and emergency protection of rocket engines and power installations.

### **Specifications**

- magnetic field strength registration range - from minus 50 A/m to plus 50 A/m;
- number of registered magnetic field strength vector components - 3;
- electric field strength registration range - from minus 3 kV/m to plus 3 kV/m;
- frequency range of electric and magnetic field strength registration - from 20 Hz to 50 kHz;
- wavelength range for optical radiation spectral analysis - from 300 nm to 1000 nm;
- temperature registration range - from 0 °C to 1000 °C;
- Amplitude and frequency range of vibration recording - 50 g, in the range from 0.5 Hz to 12 kHz;
- Maximum measured sound pressure level - 146 dB, in frequency range from 2 Hz to 20 kHz

### **Composition**

The hardware and software complex includes the following units:

- electric and magnetic fields registration unit;
- optical spectra registration unit, based on spectrometer;
- temperature registration unit, based on pyrometer and thermocouples;
- video data registration unit;
- unit for registration vibrational and acoustic signals;
- electronics unit for receiving and processing of measurement information;
- operator's workplace