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DEVELOPMENT OF CHALLENGING TECHNOLOGY OF NOVEL STRUCTURE SYSTEM AND NON-EXPLOSIVE, LOW-COST, LOW-VIBRATION SEPARATION DEVICE OF NANO SATELLITE QSAT-EOS

Abstract

Two challenging technologies have been developed for a new nano satellite named QSAT-EOS for earth observation. Those challenging technologies are developed in the designing process of QSAT-EOS. The one is novel structure system with light weight and stronger stiffness as primary structure of small satellite. The other is non-explosive, low-cost, low-vibration separation device which is developed for the separation of satellite from rocket at final stage. Both are quite unique and useful for various small satellites.

For the novel structure system with light weight and stronger stiffness, Japanese tatami arrangement of the special room developed for tea ceremony has been converted into new arrangement of four wall structures named as "Yojo-han" arrangement. In the structure four plates are located parallel to the longitudinal axis and half part of of each wall shares a square space in the center zone and consists thrust tube for the longitudinal load from rocket. The structure is quite stiff and light. The vibrational test has been conducted and the results show that quite low maximum stress has been observed. The "Yojo-han" structure arrangement could provide quite comfortable space at the central square section of the satellite.

For non-explosive, low-cost, low-vibration separation device quite creative idea has been adapted. The satellite is bounded by Marman-cramp at the connecting part of rocket. The cramp is usually removed by exploding on separation phase of the satellite. In the new system the upper gear of the cramp is fixed by the lower gear of the cramp at separation point. The upper and lower gears are stacked at the separation point by the normal force generated by cam mechanism. When the shaft of the cam rotates, the upper and lower gears loses their normal force and the Marman-Cramp has been removed because of tension load which is exposed in advance. The measured stress is 1/5 of that of the normal procedure. Also since the new separation device does not use explosive material, there are three major advantages as 1) low vibration stress, 2) low cost, 3) safe because of non-explosive device. We could conduct separation test many times and technical staff can access the satellite just before launch. The device can be used for separation device of solar panel with small vibration stress. The small vibration stress will make the structure design easy and the reduction of structural weight can be possible.