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Batteries explosive properties characterization for LEO Satellites

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Since human started to send active satellites on the orbit they needed some energy source and means to store it. Since them there are thousands of active and inactive satellites flying on orbits around the Earth. In recent years most of the spacecrafts send in to space are equipped batteries made of lithium-ion 18650 cells. They have many advantages compare to older designs. Lithium-ion cells are about times more powerful than nickel-metal hydride cell. Their stored energy to mass ration also it is better. Their charge discharge cycle is also remarkable and makes possible operational life of a satellite for years without any significant loss of performance. With all-of those good things Lithium-ion cells come with one big trade-off: hazard of explosion. Batteries which are subjected to elevated temperature might go into thermal runaway where the cell starts to rapidly get fire and rupture. If such battery will explode it might cause to fragment its or satellite structure. To avoid this scenario European Space Agency from 2020 will implement new space mitigation requirement in which there will be set of rules regarding battery Passivation (deplete energy of batteries at the end of life and additional contamination of them from thermal runaway). Up to this day explosive forces and nature of lithium-ion cells is not well explored. Jakusz SpaceTech with ABSL are preparing research having goal is to understand what are explosive forces of the batteries. Test specimen will be single cells, 8-pack of cells, and 88 block cell with and without walls. In Batteries will be placed inside detonation chamber on heated table to cause thermal runaway. Pressures generated in thermal runaways will be compared to pressures generated by conventional explosive materials. Based on this data there will calculated TNT equivalent (which serves as unit of explosive force) for lithium-ion cells. future this will information will be key element for designing contamination device. Next company will plan to make tests in vacuum with witness sheet to have a reference for future tests especially in future with contamination device. If under thermal runaway all contents will be contaminated without damaging witness sheets device will be declared as serving it goal.

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