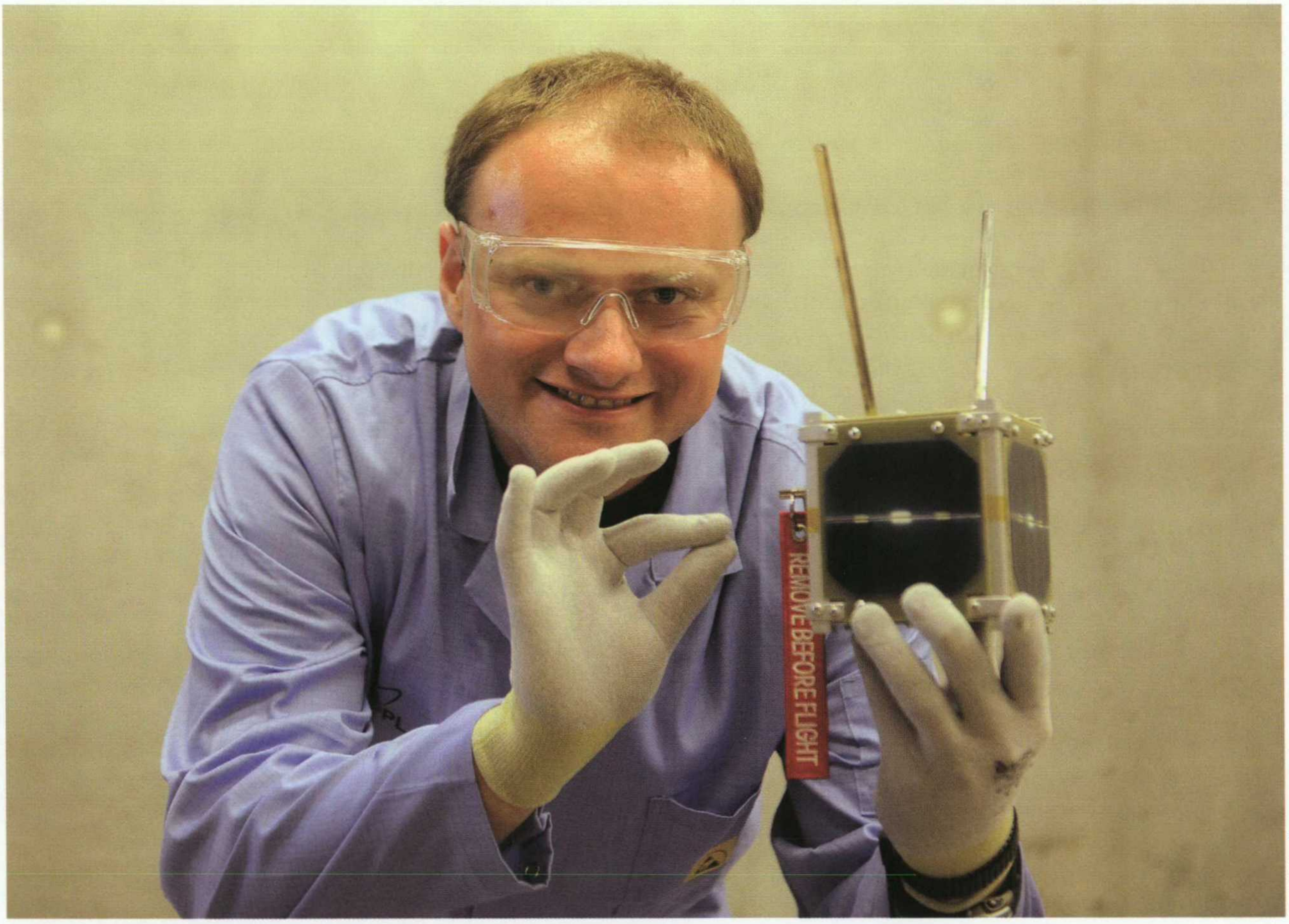

Jakub Ostałowski

As Delicate as a Satellite

MARCIN STOLARSKI
Space Research Center
Polish Academy of Sciences, Warsaw
mstolars@cbk.waw.pl

Dr. Marcin Stolarski is radio communication manager in the team responsible for Poland's first scientific satellites BRITE-PL. He is also involved in other projects, such as the Solar Orbiter satellite and the development of new radio systems based on software defined radio (SDR) technologies. He won the national FameLab competition and made it into the international final. He is currently at the University of California, attending a two-month training course for "Top 500 Innovators" organized by the Polish Ministry of Science and Higher Education.

One day, when I was still a young lad and knew very little about electrostatic charge, I decided to replace the graphics card in my computer. When I touched the card, I got an electric shock. Though the discharge was minor, it damaged the card completely. That was how I discovered that electronic devices are very delicate and may be destroyed even by charges that build up on clothes. If simple everyday appliances are exposed to such risks, then it is indeed frightening to think what dangers are lurking for the electronic gear sent into outer space. One of my tasks at the PAS Space Research Center involves making sure that such gear is properly prepared and secured before its travel into space.

Building a satellite is a process that consists of many stages, with each component undergoing various tests at each stage. Simply put, a satellite must not break down. If a defect is discovered after it is sent into orbit, there is no way to remove it. Despite all the money and effort put into its construction, such a device becomes space debris. This is why satellites are built in specialized laboratories, often from scratch, as there are no factories able to deliver space gear that is sufficiently durable, reliable, inexpensive, and most importantly light - launching 1kg into orbit costs roughly $10,000.

While working on satellite components, I must remain extra careful not to damage them accidently with the charges that accumulate in my clothes or skin. This is why I wear a special lab coat, which can neutralize the charges that build up on clothes. But this protective period is over once an individual component is built. It is then put through a series of tremendously tough tests to ensure that it can withstand the difficulties of a journey into space. Scientists must stretch their imaginations to predict what might happen to gear sent into space. It takes a lot of effort not to rely on everyday experiences when designing satellites, which operate in conditions diametrically different from those on earth.

Just being launched into orbit poses a huge challenge: a rocket gets jolted into all directions and its load is placed under great burden. Satellite components are therefore installed on shakers, which look like giant loudspeakers the size of a truck, to test their resistance to vibration during launch and make sure that all screws and other fastening elements are properly secured and do not get loose. In order to avoid such situations, we use special glue. Also, we try to predict any weak spots and prevent potential cracks, for example by using elastic joints in places most likely to be exposed to damage.

A satellite operates in extreme temperatures in space. It is exposed to sunlight, which might burn through the installation. In the shade, however, temperatures are very low, so such elements as batteries may easily freeze. In addition, vacuum is an excellent insulator, so devising solutions to regulate temperature on board satellites poses a considerable challenge to engineers. Satellite components are placed into special vacuum chambers with powerful lamps that imitate sunlight to test their resistance to overheating.

Another challenge for satellite engineers is the absence of air. Although computers do not breathe, they do generate a lot of heat. Down on Earth, the simplest way to cool them involves using air: every owner of a personal computer is surely familiar with the characteristic humming sound of computer fans. But this solution will not work in space. It is therefore necessary to design special hydraulic cooling systems.

But despite all these efforts, the satellite failure rate remains high. Simply put, the reliability of satellites largely depends on the funds allocated for electronic gear. Some satellites, for example Voyager, have remained in use for several decades. Others, for example on the Venus mission, break down very quickly. Another extremely important factor is how experienced the satellite-builders are, and the PAS Space Research Center can boast many achievements in this field. We are getting ready to launch Poland's first two scientific satellites (the start is slated for late 2013), but for many years the Center has been involved in the construction of satellite components that are currently in use on Mars or on one of Jupiter's moons. Polish scientists specialize in missions regarded as impossible: our teams were often given many projects only after other teams refused, arguing that a certain solution was impossible. We may be short on funding, especially for lab equipment, but we have no reasons to feel inferior. I am convinced that we are among the world's leaders. ■