APPLICATION STORY

FLIR test and measurement tools help students to get ready for SpaceX competition

Here's a challenge: build your own Hyperloop pod prototype and test it at Elon Musk's SpaceX headquarters in California. Who said engineering can't be fun? Engineering students from the University of Edinburgh who were accepted to participate in the exciting SpaceX Hyperloop Pod competition used thermal imaging and measurement technology from FLIR to make sure their prototype was ready for the race.

FLIR CM275 Clampmeter with IGM.

FLIR E4 handheld thermal imaging camera

Through IGM, the CM275 provides a reliable way to identify hot spots and overloaded circuits.

Traveling from city to city at 700 miles per hour in an underground vacuum tube seems futuristic to some of us, but not to entrepreneur Elon Musk. The forward-thinking CEO of Tesla and SpaceX sees this as the next step in mass transportation technology. Hyperloop is Musk's concept of electrically propelled pods traveling autonomously through a near-vacuum tube. The pods will be able to reach speeds comparable to aircraft and could see a journey such as Edinburgh to London shortened to 50 minutes.

A yearly competition draws many engineering teams from around the world to the SpaceX headquarters in California. There, SpaceX challenges the teams to develop their own Hyperloop pod prototype and test it in a mile-long vacuum tube.

HYPERLOOP TEAM

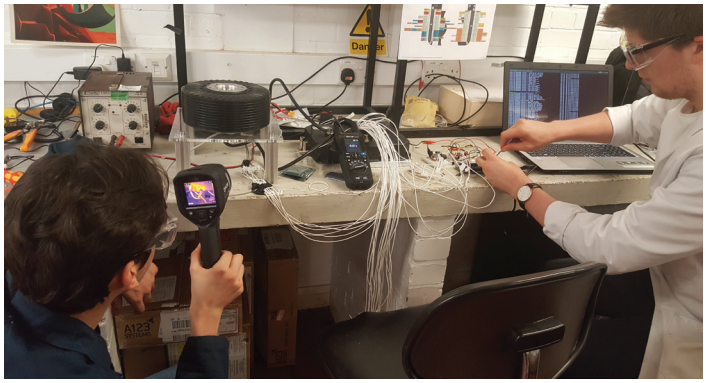
One of the engineering teams that joined the 2018 competition is HYPED, a student society at the University of Edinburgh. The team consisting of more than 100 members has been focusing both on the technical and commercial development of Hyperloop. Their designs have already seen success in two international competitions.

In the 2018 competition, the HYPED team wanted to push the boundaries of the Hyperloop technology in a new prototype that featured magnetic levitation, electrodynamic (Halbach) wheels for propulsion and high-speed braking, emergency pneumatic brakes, and a carbon composite pressurized vessel.

EFFICIENT POWER MANAGEMENT

"As a student society, our budgets and capabilities are rather limited," says Daniel Toth, Head of Power at HYPED. "The first time we can actually test our prototype on a larger scale is at the SpaceX facilities. So, it is very important that we can thoroughly test every individual component well in advance, starting with smaller test setups, but then gradually increasing the size of our tests."

Toth heads the group involved with power management (battery packs and related electronics), usually an area of expertise where things heat up before they break. Next to a lot of simulation work, the HYPED



Thermal imaging cameras offer the HYPED team a safer, contactless way to inspect battery packs and electronics.

Daniel Toth: "The FLIR CM275 clamp meter is great for quick diagnostics, while the FLIR E4 thermal camera was handier for longer and more comprehensive inspections."

team also performs destructive tests of components to discover the performance limits of their designs.

"With electrical components and battery packs, heat usually indicates that something goes wrong, so it is only logic that thermal imagers are part of our toolkit," Toth explains. "Thermal imaging is an ideal technology to see weak points in the design and it enables us to see where we can make improvements. Electronic components will also behave differently in a vacuum, because there is no air cooling. It's important to test these conditions very thoroughly."

THERMAL IMAGERS AND CLAMP METERS

The HYPED team has been using a FLIR E4 thermal imaging camera and a FLIR CM275 clamp meter with thermal imaging. "We found that the FLIR CM275 clamp meter is great for quick scanning and diagnostics, while the FLIR E4 thermal camera was handier for longer and more comprehensive inspections that involved more people," says Toth.

The power of the FLIR CM275 lies in the fact that it combines two modes of operation that work well together. Through Infrared Guided Measurement (IGM™), the CM275 provides a reliable way to identify hot spots and overloaded circuits from a safe distance. With the clamp meter's wide range of functions and accurate temperature readings, users can confirm their findings.

"Even in thermal imaging mode, you can still use the meter readings, so having both in one device is very efficient," says Toth. "To me, it is much more reliable when you can crosscheck your results between different modes of operation."

AVOIDING SAFETY RISKS

Working with batteries always includes risks. Batteries contain toxic liquids and charging them with high currents will cause them to heat up. Especially the plastic casing of cables leading to the interface can melt or catch fire. In the worst case, batteries will vent, which means that they can suddenly release dangerous gases and liquids when under pressure.

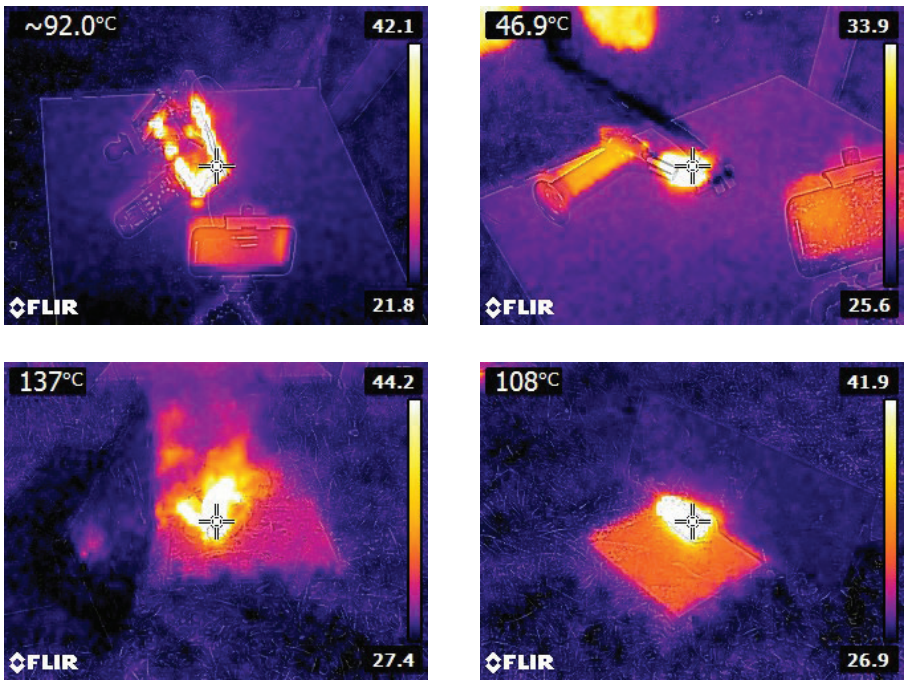
With conventional tools such as thermistors or thermocouples, the user needs to take measurements with the tool contacting the object of research. Thermal imaging cameras offer the HYPED team a way to inspect battery packs and electronics from a safer distance, without making contact.

VARIETY OF APPLICATIONS

Toth also owns a FLIR ONE® thermal imager for smartphones—a tool he says really taught him to appreciate the power of thermal imaging. "Having worked with electronics for quite some time now, thermal imaging has always come in handy for electronics inspections. That is why I am looking forward to using the FLIR tools for even more applications."

Testing the prototype's propulsion system and motor control unit are on the HYPED team's to-do list. The team needs to cool all these systems efficiently, a task that Toth believes can really show the value of thermal imaging.

"Building a prototype during a one-year competition can be stressful at times, but fortunately, tools like thermal imaging cameras and clamp meters, help us to stay on schedule and make reliable measurements."



Thermal imaging is an ideal technology to see weak points in the design of electronics or battery packs.

For more information about thermal imaging cameras or about this application, please visit:

www.flir.com/test

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