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Case Study

Harwin Dares to venture into the Stratosphere

Datamate Connectors to travel at three times the speed of sound

By Paul Gillam, Datamate Product Manager, Harwin Plc

Launched in Spring 2009, Stratos is the most extreme short-term project attempted to date by [DARE](#), the Delft Aerospace Rocket Engineering society of students from the Delft University of Technology in the Netherlands who design, build and launch experimental rockets. Stratos will travel at three times the speed of sound to an altitude in excess of 15 kilometres, accumulating flight data and carrying a payload of experiments designed to increase the pioneering university's knowledge and expertise of operating in the stratosphere. Ensuring that the electronic systems communicate and function correctly are [Datamate connectors](#) from Hi-rel connector maker, Harwin.



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Stratos' main aim is to break the European advanced amateur rocket altitude record which currently stands at 10.6 km. The student project carries a design project payload, and will also provide the basis for the development of next generation rockets. The rocket consists of two stages. First, there is an expendable booster which will propel the rocket close to the speed of sound. The booster will detach after burn-out, followed by the main thrust stage of about 15kNs, propelling Stratos to an apogee of about 15 kilometres. During flight the rocket will reach Mach 3 (3500 km/h).

A large part of the rocket will not be recovered, but all the valuable data, electronics and payload experiments will be jettisoned and landed safely by parachute. The flight computers will also have a wireless data downlink for telemetry, ensuring complete evaluation of the flight, even if the electronics capsule is not found. The Stratos payload includes an Inertial Measurement Unit (IMU) developed and built by aerospace students from the TU Delft, utilising accelerometers, gyroscopes, inclinometers and temperature sensors.

Reaching extreme altitudes poses extreme challenges. One of the most significant challenges is the high velocity at which this rocket will need to travel, requiring high performance engines, and lightweight yet strong structures. Extreme cold is also a problem, as at the launch site in northern Sweden, inside the polar circle, temperatures of twenty degrees below zero are expected. Lastly, Stratos and its electronic systems will be subjected to rapid acceleration, high G force and heavy vibration - especially during take-off.



Location of Esrange in Sweden

The electronics segment is an integral part of the Stratos rocket, and is designed, built and programmed by the electronics department of [DARE](#). The function of the electronics is to respond to events and trigger functions of the rocket that are necessary for a proper flight. The electronics is responsible for the control of the pyro charges for the separation of the first and second stage, the ignition of the second stage and the control of the servo system performing the deployment of the parachute system. Furthermore it also has capabilities to log the data provided by its measurement components.

The electronics is built in a modular way. The central part is a master control unit (MCU), responsible for communication between all other components. Multiple pyro boards and servo boards are present which control functions on other modules such as the ignition of the main motor and recovery systems and the release mechanism. The rocket also features measurement and data storage boards and a transmitter. The measurement board measures the orientation of the rocket using an inertial measurement unit and the environmental conditions by using a pressure and temperature sensor. This data is forwarded to the data storage board and the transmitter, which respectively store the data on a memory card and transmit the data to the ground. The MCU is also connected to a camera and GPS.

[Datamate connectors](#) provide the primary link between all the flight hardware. Datamate is a 2mm pitch cable-to-cable, cable-to-board and board-to-board interconnection system. This miniature connector family has been proven in harsh operating conditions many times, having been selected as the interconnect of choice on programs such as the so-called 'Nano' space satellites (also termed Cubesats) that measure just 10x10x10cm, the Neutrino telescope buried deep in the polar ice, Bowman military radio, missile guidance systems, dialysis equipment and patient monitoring systems and Formula 1 telemetry systems.



Overview of the Stratos rocket

Comments DARE's Frank Engelen: "In previous projects, [DARE](#) used standard connectors. However, during the integration design phase we needed to miniaturise the electronics systems so that they fitted into

the rocket. So we turned to Harwin's Datamate connectors because of their small size and also the good results that the Delfi-C? Cubesat team had with these components. More, as Stratos will be launched at Esrange above the polar circle, the connectors have to cope with extremely low temperatures. Lastly, during the rocket's flight the connectors will have to cope with large acceleration forces (30 g) and heavy vibrations. We chose to use Datamate J-Tek connectors with secure jackscrew mating to ensure that they would cope with the severe operating conditions."

[Datamate](#) connectors are rated for operation between -55 and +125degC with a vibration sensitivity of 10Hz to 2000Hz, 0.75mm, 98mm/s? (10 g) for a duration of six hours. Bump severity is 390m/s? (40 g), 4000± 10 bumps; shock severity is 981m/s? (100 g) for 6ms, and acceleration severity is 490m/s? (50 g). Environmental classification is 55/125/56 days at 95% relative humidity. Mechanically, Datamate is guaranteed for 500 operations.

[Datamate contacts](#) are rated at up to 3A for signal purposes and 20A for power applications (Mix-Tek Datamate). This compares very well with other commercially-priced, twin-beam 2mm connectors whose contacts may only be able to handle 1A.



Motor test of the main motor

Datamate comes in a number of different families. [Datamate L-Tek](#) offers friction latch, locking latch and no latch mating options. [Datamate J-Tek](#) includes the security of jackscrews, and [Datamate Mix-Tek](#) includes signal, power and coax (up to 6GHz) contacts. All devices are available with the added security of 100% in-process testing (Datamate Plus) and for customers who require full BS9525-F0033 approval, there is BS Datamate. Recently, Harwin has also introduced Datamate Trio-Tek devices which feature open barrel crimp contacts, automating the crimp process, saving assembly time and reducing process costs.

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