
VAISALA

OBSERVATIONS FOR A SAFER WORLD

38 million flights every year from 40,000 airports around the globe, carrying 2.5 million passengers every day and all relying on safe procedures to get them in and out of the air. Offering Manager **Kari Luukkonen** from Vaisala explains how Vaisala technology does just that at airports with some of the most challenging conditions in the world.

A world full of sensors

Vaisala's history may have begun over 80 years with commercialisation of a single "radiosonde" product, designed to measure temperature, humidity, pressure, wind speed and direction in the upper atmosphere but today the company produces over 6,000 products. From high end humidity and carbon dioxide measurement for demanding industrial applications, to air quality measurement that protects our citizens, all these sensor technologies help us to better understand and influence our environment. There is no better example of where sensing takes a centre stage than at airports around the world. Over the last 40 years Vaisala has installed weather systems at airports in over 100 countries.

Keeping our airports operational

We all expect our airports to remain operational whatever the weather and that demands a whole series of measurements. Fig 1. illustrates some typical measurements and the principles employed.

Demanding Heights and Low Temperatures

Located well over 4 km above sea level, Daocheng Yading Airport in China is the highest civil airport in the world. The challenges posed by its altitude and low temperatures even on a runway over 4000m in length make it unprecedentedly difficult for aircraft to approach and land at the airport. Aircraft performance in extreme conditions is reduced and its essential to measure the airport's outline weather parameters, such as wind, pressure, temperature and humidity, as well as specialised aviational parameters like runway visual range. Winds can be much stronger at high altitude making it crucial to measure their strength and impact on airport operations. Accurate measurement of clouds height is critical as they can be very close to the ground while reliable measurement of atmospheric pressure in thin air conditions is needed to understand any impact on engine performance.

To do their job properly, the sensors must be protected against windblown particles such as sand which could otherwise affect the measurement accuracy in the windy conditions and the sensor technologies themselves must also be suitable for operation in varying climates from the tropics to the arctic or where temperature shift between day and nighttime is large. In the case of Daocheng Yading we use high-power heaters that compensate for the effects of the cold climate as well as the accumulation of snow.

Sensor manufacturing challenges

The accuracy of measurements is the key in our instruments and systems and the sensors at their heart are critical. Vaisala sensors are designed for harsh and extreme conditions and customers' expectations are that performance of the product is stable in all conditions. To ensure repeatable, accurate sensor performance in demanding conditions, our sensor manufacturing processes and our manufacturing equipment must also be reliable.

The goal for our sensor manufacturing equipment is to keep the overall system uptime high and maintenance low. All sensors have thin film technology at their heart and we use custom thin film processes and substrate handling in our evaporation and sputter systems. The challenges are to maximise process yields and in handling peaking demand across the many sensor types in our portfolio.

Vaisala – at an airport near you

Next time you are at an airport taxing for take off in windy, low visibility or other harsh weather conditions I hope you will take a look out of the window. It may well be Vaisala technology that's keeping you safe.

VAISALA

About Vaisala

We deliver products and services for environmental and industrial measurement from our headquaters based in Helsinki, Finland. Our company employs approximately 1,600 people and exports 98% of its production to over 150 countries. Innovation and the desire to meet challenges are at Vaisala's core. To do this the company spends 12% of its annual net sales revenue in R&D.

To find our more go to www.vaisala.com

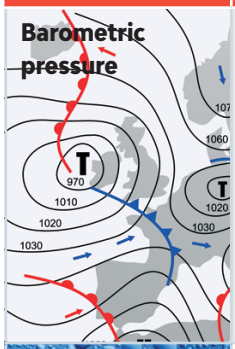
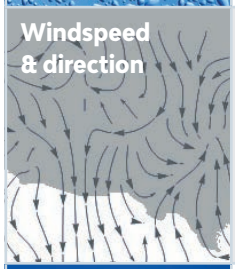
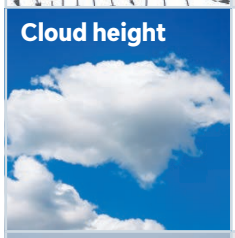
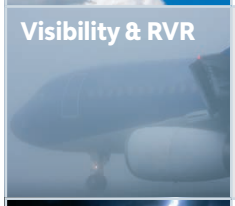
Measurement	Relevance for aviation	Measurement principle
	▪ Aircraft altitude reading	**PTB330** uses micromechanical BAROCAP sensor that uses dimensional changes in its silicon membrane to measure pressure. As the surrounding pressure increases or decreases, the membrane bends, causing changes in the capacitance of the sensor. thereby increasing or decreasing the height of the vacuum gap inside the sensor. The opposite sides of the vacuum gap act as electrodes, and as the distance between the two electrodes changes, the sensor capacitance changes. The capacitance is measured and converted into a pressure reading.
	▪ Aircraft take-off/landing speed ▪ Aircraft maximum loading weight	Using **HMP155**, air temperature is measured by a platinum type (PT100) sensor and relative humidity is measured by a thin film type sensor HUMICAP®180R(C). Changes in humidity is detected by a change of capacitance in the polymer layer of the sensor.
	▪ Aircraft take-off/landing ground speed (headwind) ▪ Landing safety (crosswind)	**WMT700** series uses ultrasound to determine horizontal wind speed and direction. The measurement is based on transit time, the time it takes for the ultrasound to travel from one transducer to another, depending on the wind speed. The transit time is measured in both directions for a pair of transducer heads. Using two measurements for each of the three ultrasonic paths at 60° angles to each other, WMT700 computes the wind speed and direction.
	▪ Pilots ability to see airport (vertical) ▪ Approach method: Visual (VFR) or instrument (IFR)	The **CL31** employs pulsed diode laser LIDAR technology, where short and powerful laser pulses are sent out in a vertical or near-vertical direction. The reflection of light, backscatter, caused by clouds, precipitation etc. is measured as the laser pulses traverse the sky. The resulting backscatter profile, i.e. signal versus height, is stored and processed and the cloud bases are detected.
	▪ Pilots ability to see airport (horizontal) ▪ Approach method: Visual (VFR) or instrument (IFR)	**FS11** transmits pulses of infrared light and detects the light scattered by airborne particles. The intensity of the received pulses is measured and converted to Meteorological Optical Range (MOR) using algorithms of FS11 sensor.
	▪ Lightning damage, Microbursts / Wind Shear, severe turbulence ▪ Ground personnel safety, no refuelling	**TSS928** detects optical, magnetic, and electrostatic pulses from lightning events to report cloud and cloud-to-ground lightning within 30 nautical miles (56 km).

Fig 1

"Thin film technology is at the heart of each and every sensor we make."