How **Automatic Weather Stations** Work

Automatic METARs (known as METAR AUTO) are produced by Automatic Weather Stations (AWS). They use laser ceilometers to detect cloud layers, and sensors to determine visibility and present weather – replacing the traditional human observer.

MetService is in the process of introducing a new generation of AWS to its network. Automatic METARs are currently produced at Kerikeri, Whangarei, Tauranga, Rotorua, Gisborne, Napier, Paraparaumu, Woodbourne, Nelson, Hokitika, and Invercargill. They will be introduced at New Plymouth, Taupo, and Pukaki on 1 December 2008. Another 15 will be added to the network by the end of 2009.

Unlike manual observations, AWS report new data every minute of every day and automatic METARs are produced from this data every 30 minutes.

How Does it Work?

The sensors used to determine cloud layers, visibility, and present weather, are accurate and highly reliable systems that meet worldwide industry standards. They do not, however, scan the sky in the way that a human observer does.

Cloud is determined by recording laser signal echoes reflected from clouds, and sorting these into layers. The laser 'sees' the movement of cloud across the laser beam (directly above the weather station). This data is averaged over 30 minutes, with a strong bias towards data for the 10 minutes before each automatic METAR is produced, giving an accurate picture of the height and extent of each cloud layer. The advantage of ceilometer measurements is that they are taken over the aerodrome, whereas manual observations are mostly estimated from cloud on nearby hills, which may be quite different to the cloud base above the aerodrome.

When the AWS does not detect cloud "NCD" is reported, and when it does detect cloud three strokes "///" are placed at the end of each cloud layer group to show the AWS doesn't have the ability to identify TCU or CB cloud types.

The visibility sensor takes a spot measurement of the clarity of the atmosphere. It uses an infrared light transmitter and receiver to measure the amount of light scattering caused by rain, fog, dust and haze. The data collected over the previous 10 minutes is averaged to produce the visibility reported in an automatic METAR. "NDV" indicates that directional visibility variations are not reported. It cannot identify adjacent visibility reductions such as fog near the aerodrome. AWS at some locations

are capable of reporting visibility up to 60 km (Paraparaumu), while others are only designed to measure up to 50 km (Tauranga, Rotorua, and Invercargill), or 20 km (Kerikeri, Whangarei, Gisborne, Napier, Nelson, Woodbourne, and Hokitika).

The ICAO definition of visibility is, "the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background". Simply being able to see a mountain range 80 km away does not imply that the visibility is 80 km.

To calculate present weather, an algorithm is used to combine precipitation detected by the sensor, with visibility and temperature measurements. When the AWS does not detect a reportable present weather condition, two strokes "//" are inserted in the present weather field. "TS" is added to the present weather field if lightning is detected by MetService's Lightning Detection Network within 8 km of the aerodrome, and "VCTS" is added if it is detected between 8 and 16 km from the aerodrome.

Wind data comes from an anemometer usually mounted on a 10 metre mast, and QNH is measured by an electronic barometer using three independent pressure sensors.

The operation of the new AWS installations and the production of the automatic METAR meet, and in some aspects exceed, well founded internationally prescribed standards.

Examples from MetFlight-GA:

NZRO:

METAR 200100Z AUTO 22013KT 190V250 33KMNDV -SHRA OVC048/// 19/16 Q1021

NZPP:

METAR NZPP 202000Z AUTO 09005KT 60KMNDV // NCD 06/02 Q1019

The Big Picture

METARs report the actual weather at an aerodrome, they are not a forecast. What they report relates to an 8 km cylinder around an aerodrome. They are one part of the big weather picture.

METARs (whether manual or automatic) should always be read in conjunction with all available meteorological information, particularly forecasts.

Aerodrome forecasts (TAFs) are expected to become more accurate for aerodromes with AWS. TAFs also relate to an 8 km cylinder around an aerodrome. They are issued daily at 1600 UTC, between 2030 and 2200 UTC, and at 0400 UTC for aerodromes with night operations. They are amended when significant changes occur, or are forecast to occur. Before the introduction of automatic METARs, manual METARs were limited to the operational hours of ATC towers, and forecasters were often unable to check their 1600 UTC TAF against actual conditions until the first manual METAR was produced at 1800 UTC. Now that AWS provide forecasters with data every minute of every day, this greatly improves their ability to detect the early signs of change.

Other essential sources of meteorological information include:

ARFORs – the 17 Area Forecasts covering New Zealand give forecast winds up to 10,000 feet, cloud, freezing level, visibility, and significant weather such as turbulence.

SIGMETs – these forecast severe weather conditions that may be hazardous to flight.

MetFlight-GA has weather radar imagery from five sites, showing the extent, intensity, and movement of precipitation over much of the country. Both infrared and visible satellite imagery is also available (visible imagery is good for seeing where cloud and fog is around the country), as well as mean sea level analysis and prognosis charts.

Make use of web cameras around the country too, and any contacts you have at aerodromes or en route by calling them to ask what the weather is doing. Use both automatic METARs and these personal observations to help build on the picture you gain from studying the ARFORs and TAFs. ■