Wind Gauges

Introduction

Some wind gauges particularly propeller gauges are known to be inherently inaccurate (see a separate paper).

The IAAF Technical Committee should provide guidance to federations on acceptable means of calibrating wind gauges.

History

At a meeting in London on 12 July 1991 the then IAAF Technology Working Group proposed the following:

Regulations for Acceptance of Wind Gauges by National Federations

- The fact that the wind gauge is in the measuring mode must be apparent.
- The wind gauge must correctly and visibly indicate the direction (+ or -) of the wind. (*This depends on where the wind gauge is located beside a jumping runway)*
- The wind gauge must be tested in an officially certified wind tunnel in both directions between +2m/s (+4m/s) and - 2m (-4m/s). The accuracy at 2 m/s should be +/- 0.01 m/s. (*I consider that the bracketed figures are the more appropriate).* The construction of the wind gauge can not be changed after testing in the official wind tunnel. If any change has been made, a new test must be performed.
- The tests should be conducted at varying temperatures (+15 ^{o} to 40 ^{o} C). *(In view of the cost of testing this should only apply to the certification test of the particular instrument for a Product Certificate)*
- The gauge should yield correct values not longer than 5 minutes after installation.
- The gauge should be tested for ability to indicate gusts. (*As the gauges are provided with velocity averaging this is impracticable. Of more importance is the responsiveness of the gauge to change of wind speed due to the inertia of moving parts in the case of propeller gauges. This is not generally tested.*)
- The gauge should indicate no values prior to the definitive one. (*At least some makes of propeller gauge show the figure momentarily as it goes through the averaging process.*)
- There must be a facility to restart the time measurement whenever required. The device must be designed so that it can be operated from a distance of 2 metres. (*Most propeller gauges do not have this facility.*)
- The manufacturer must supply a controlling gauge to the National federation. This gauge must also be officially tested. It should be accurate to 2 decimal places. There must be the possibility to set it to the wind-strength values of 2, 3 and 4 m/s. This control gauge must be tested once a year. (*The purpose of this requirement and how it is to be used is not clear. Provincial associations or clubs rather than national federations own most of the existing wind gauges.*)

- The wind measurements should not be sensitive to changes in light and temperature. (*It is not clear what effect light would have. Atmospheric pressure and humidity that along with temperature are the factors affecting air density.*)

I believe these regulations were accepted at the subsequent Technical Committee meeting but never implemented. I have added some comments above in Italic.

Other Studies

In 1997 a Finnish laboratory tested an ultrasonic wind gauge and two tube (propeller) wind gauges. It was found that the propeller wind gauges were particularly susceptible to side wind showing an error of 30% at a wind angle of 60 degrees to the gauge axis whereas the same gauges were shown to be in calibration for parallel wind in both directions.

It was noted with high wind sideslip angles the tube-type wind gauges have flow separation at the upstream end of the tube so that the flow is not uniform at the propeller.

The ultrasonic wind gauge tested also had a side angle error at one angle but this may have been due to a construction feature of the particular gauge.

Therefore it is essential that wind gauges be tested at side wind angles.

The process undertaken by the Finnish laboratory is of interest and relevance. Firstly the gauge was adjusted so as to correctly measure a velocity of 2 m/s parallel to the tube. After the adjustment the gauge was calibrated from 0.5 m/s to 5 m/s at 0.5 m/s intervals in both directions for a time of 5 seconds. The effect of side wind was undertaken with the velocity component parallel to the gauge of 2 m/s for a time interval of 5 seconds at angles -60^{o} to $+ 60^{o}$ at 15^{o} intervals. The time calibration was undertaken at 5, 10 and 13 seconds at velocities of +2 m/s and - 2 m/s.

None of these calibration exercises test check how the instrument reacts to a gusting and veering wind. In the case of propeller gauges the inertia of the propeller could be important and this should be checked.

Discussion

The Manager of the CSIRO Wind Tunnel in Victoria where some Australian wind gauges have been tested had some interesting comments to make as follows:

Standards: There are no international standards for the type of gauge we use.

Calibration: It is only at air speeds of less than 2 m/s that the air density variations normally encountered near sea level will introduce an error greater than 1 per cent.

Accuracy: The accuracy is linked to the instrument resolution and uncertainty plus the calibration facility uncertainty. The wind tunnel uncertainty is 1%.

Ultrasonic gauges: These are susceptible to rain induced errors and are sensitive to direction.

Separately Henry Cardenis of Gill noted that humidity, pressure and temperature influence ultrasonic wind measurement. The Gill ultrasonic wind gauge is advertised as having an accuracy of ± 2% of absolute wind speed.

Most propeller wind gauges are operated manually by an operator sitting close to the wind gauge with some obvious affect on wind readings. At least some ultrasonic wind gauges are provided with remote start capability.

We recognise that the way we measure wind can only be at best an indication of the strength of the wind that athletes may encounter or enjoy in a sprint or during a horizontal jump run-up. However, we need to have reliable and accurate instruments that will indicate whether wind was a significant factor in a performance.

Gauges should have an easy method of adjustment not readily accessible to the normal user.

The Way Forward

I recommend that the Committee:

1. Agree on a set of calibration criteria, as given in a separate paper based on the Finnish laboratory model.
2. Ask the manufacturers to comment on the criteria.
3. Once the criteria is agreed, obtain competitive quotations from suitable testing laboratories for testing wind gauges to the criteria so that the IAAF will have a likely cost benchmark.
4. Ask the manufacturers of wind gauges currently on the market to submit one of their instruments to the IAAF for testing at a nominated laboratory using the agreed calibration criteria.

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