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INTERNATIONAL ORGANIZING COMMITTEE (IOC) ON  
SURFACE-BASED INSTRUMENTS INTERCOMPARISONS  
*First Session*

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**WMO HYGROMETER AND THERMOMETER SCREEN INTERCOMPARISON**  
***Proposals and guidelines for its preparation and running***

*(Submitted by Mr J. van der Meulen, invited expert)*

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**Summary and purpose of document**

This document provides information on and guidelines for WMO Hygrometer and Thermometer Screen Intercomparison as submitted by Mr K. Hegg, Norway, to the Working Group on Surface Measurements, 27-31 August 2001.

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**Action proposed**

The meeting is invited to take into account information presented in this document when discussing combined intercomparison of thermometer screen/shields with humidity measurements.

## **WMO Hygrometer and Thermometer Screen Intercomparison - Proposals and guidelines for its preparation and running<sup>1</sup> -**

### **1 Background**

CIMO-XII, Casablanca, 1998, suggested that a WMO hygrometer intercomparison should be held during the next intersessional period. It was proposed that the intercomparison should be established in another climatic area than the previous one, hosted by DNMI of Norway in Oslo<sup>2</sup>. Emphasis should be put on the performance of hygrometers when used in climatic regions with high temperatures. It was also suggested that it might be feasible to combine a hygrometer intercomparison with ongoing intercomparisons of thermometer screens.

### **2 Thermometer screen intercomparison**

Carrying out intercomparisons between different thermometer screens, used in a specific region, is very important with respect to maintain the homogeneity and comparability of observations. It has to be underlined that in addition to the traditionally, at manned observing stations used screens, also an increasing number of new screen designs are applied, especially in connection with the automation of observations. To prevent that long-term climatological data-sets will seriously be biased by the introduction of new thermometer screen designs, considerations on organizing international intercomparisons of thermometer screens, at least within the main climatological regions, is very important. When planning such a test, both the traditionally used screens and the operationally in the climatological regions of concern applied new designs should be well represented.

### **3 Hygrometer intercomparison**

Although there has not been a lot of really new type of hygrometers developed since the last WMO hygrometer intercomparison was carried out in the second half of the 1980<sup>th</sup> already, it is supposed that some manufacturers have taken considerable efforts in improving the characteristics of their sensors, both with respect to accuracy and long-term stability. High quality humidity measurements tend to be most difficult for very high as well as very low humidity. Furthermore, it should be taken into account that the mostly used humidity sensors do have a temperature dependency in its measurements, especially at low temperatures as shown in the last hygrometer intercomparison. One should also be aware that no WMO humidity sensor intercomparison had been carried out within warm and humid climatological regions within the last decades.

To obtain good knowledge on the performance characteristics under field conditions, such as the accuracy, long-term stability and necessary maintenance of modern humidity sensors, it is proposed to consider the preparation of a WMO hygrometer intercomparison, preferable in at least warm and humid regions as well as in warm and dry regions. An intercomparison in cold climates might also be considered, if feasible.

### **4 Site for the intercomparisons**

The Task Team, established within the Working Group for dealing with this task, proposes to take benefit from the established 13 Regional Instrument Centres (RICs) for assisting in the organization and preferably also for hosting both thermometer screen and hygrometer intercomparisons. The reason for this proposal is to make advantage of existing infrastructure at the RIC's. Such an undertaking might also be a substantial achievement for the RIC's themselves, as reflected within their terms of reference. It should be noted that presently the following RICs exist worldwide:

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<sup>1</sup> The Working Group may take note that in case it will be agreed upon to carry out such intercomparisons, the President of CIMO will establish an International Organizing Committee (OC) to define in detail its preparation and running, the objectives, requirements, rules for participation, etc. (see *CIMO Guide* (WMO-No. 8, sixth edition, 1996), especially Section 5.4 and Annex 5.B of Chapter 5 within Part III)

<sup>2</sup> See IOM-Report No. 38 (*WMO/TD-No. 316*) WMO International Hygrometer Intercomparison, Oslo, Norway, 1989, by J. Skaar, K. Hegg, T. Moe, K. Smedstud (all Norway)

Four in RA I, two in RA II, one in RA III, three in RA IV, two in RA V and one in RA VI.

Many of the RICs in RA I, II, III, IV and V are situated in areas with climatological conditions which seems to be preferable for carrying out such intercomparisons.

## **5 Site requirements**

The sites for the installations should be situated as close to the observers (Site Manager - SM) who are responsible for running intercomparison. This precondition should widely guarantee regular inspections of the sensors / equipment compared which may also include some reference measurements.

### **5.1 Hygrometer intercomparison**

Since a hygrometer intercomparison should provide information on the reliability, accuracy, long-term stability etc. of the tested hygrometers, it is important that the various types of hygrometers are continuously exposed to the same humidity. All hygrometers that are intended for application inside of screens or shieldings should be, as far as possible, installed in one screen only. To ensure that all sensors inside the screen are exposed to the same humidity, the screen should be artificially ventilated. This may require a fairly big ventilated screen.

Most probably some of the sensors to be compared are designed for an unprotected use, i.e. they have to be mounted outside of any thermometer screen to compare them under real measuring conditions. This requires a careful selection for a proper exposure. The comparison site must be open, away from trees, and no water vapour sinks or sources should be available close to the installations. A suitable site could be an open horizontal area with grass-covered surface. The distance from the installations of the sensors to any obstacles that might influence the humidity should be large enough to ensure uniform humidity conditions for all sensors tested.

### **5.2 Thermometer screen intercomparison**

The site requirements for a thermometer screen intercomparison are still more extensive. It will be especially important that all the screens are exposed to the same solar radiation and influences of compared screens to neighbouring screens must be avoided. This means a rather big uniform area to ensure reliable screen intercomparisons. The requirements on the homogeneity of the test field will be extremely important. Special emphasis must be paid to the siting of reference screens.

## **6 Reference hygrometers and thermometer screens**

No absolute reference instruments are available for any of the suggested intercomparisons. Therefore the Task Team suggests using relative references.

### **6.1 Hygrometer intercomparison**

It is recommended that at least two different principles of reliable dew point meters and/or electrical psychrometers should be used to build a reference value for the hygrometer intercomparison. It has to be guaranteed that the reference will be able to provide stable measurements during the intercomparison period. There should be at least two reference instruments included.

Some further procedures must still be defined to guarantee reliable measurements of high accuracy of the reference instrument(s) used, for instance regularly checking their performance against certified standard instruments, which are not included in the intercomparison itself, probably to be done in a laboratory.

### **6.2 Thermometer screen intercomparison<sup>3</sup>**

It would be preferable to use as reference a screen that has operationally been used for a significant long time in the specific climatological regions of interest, i.e. which is the most representative for this area. To be able to properly compare the results obtained from the various

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<sup>3</sup> See also document INF 4: IS/TC 146/SC 5 WG3 N 10 "Meteorology – Air temperature Measurements – Part 1 Test methods for comparing the performance of thermometer shields / screens and defining important characteristics" (draft).

intercomparison sites, the same type of thermometer screen should be installed at all sites in addition. An artificially thermometer screen might be considered as common reference.

## **7 Combination of hygrometer and thermometer screen intercomparison**

Before considering the combination of the two proposed intercomparisons, the following items should be considered:

### **7.1 Benefits of a combination**

- The same data acquisition system can be used;
- The same or a very similar set of influencing variables have to be observed;
- The servicing and maintenance of the site and the instrumentation is similarly and no significant additional efforts have to be made;
- Data processing and evaluation might follow the same lines;
- A possibility of using the same references both for the hygrometer intercomparison and for the thermometer screen intercomparison

### **7.2 Drawbacks for a combination**

- Site requirements are slightly different although a site that will be satisfactory for the thermometer screen intercomparison is most certainly well suited for the hygrometer intercomparison;
- Increase of installation and servicing work for the host country, while it depends on objectives of the test and especially on the rules set-up by the International Organizing committee (OC);
- Slight increase of the real-time evaluation work and the distribution of interim results by the Site Manager (SM) to the Project Leader (PL) of the whole test during the intercomparison period.

## **8 Other issues related to the duties of the host countries**

Both the workload and the financial responsibility for any host country might be considerable. Therefore the Task Team proposed to consider the possibility of sharing the responsibilities between different host countries. The discussion could be based on the following matters:

### **Minimum requirements for a host country:**

- Provision of the intercomparison site;
- Preparation of the site;
- Installation of the screens and sensors;
- Provision of the necessary cabling for data acquisition;
- Provision of a room or similar for installation of the data acquisition equipment;
- Provision of staff for doing the necessary regular work during the intercomparison period (including visual inspection, logging of events of any kind that might be of importance for the intercomparison etc.);
- Nomination of a Site Manager;
- Make raw and evaluated data available according to the rules established.
- .... (to be continued if needed)

### **Additional requirements** (can optionally be provided by another member)

- Provision of appropriate data acquisition equipment;
- Provision of sensor calibration facilities and of suitably calibrated sensors;
- Data analysis and preparation of regular reports according to the requirements.
- .... (to be continued if needed).