WORLD METEOROLOGICAL ORGANIZATION

INSTRUMENTS AND OBSERVING METHODS

REPORT No. 54

INSTRUMENTS DEVELOPMENT INQUIRY

(Fifth Edition)

by

Dr. J.P. van der Meulen

December 1993

WMO/TD – No. 578

W O R L D M E T E O R O L O G I C A L O R G A N I Z A T I O N

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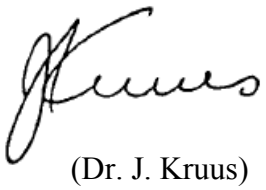
FOREWORD

The provision of compatible measurements of high quality is fundamental for the operational and research programmes of the World Meteorological Organization. Therefore, the development and use of new technology for effective and economical acquisition of data and, in particular, for the automation of observations is considered to be of great importance. The Eleventh Congress of WMO urged that Members of WMO continue and, to the extent possible, increase their programmes for the development of new data acquisition systems, sensors and instruments, including those for monitoring the composition of the atmosphere.

WMO, and particularly the Commission for Instruments and Methods of Observation (CIMO), has for a long time been publishing information on new developments in instrumentation and observational techniques. Since 1968 four editions of a publication with the title of "Instruments Development Inquiry", have been published. This, the fifth edition of the Instrument Development Inquiry, contains the results of a comprehensive survey of the state-of-the-art in development of meteorological instruments and of the new instruments introduced into service during the last four years. The information was provided by 23 Members in 143 completed questionnaires.

The information in this publication will assist Members in the transfer of technology and in selecting equipment for use in new applications or as replacement for obsolete instrumentation. Availability of this publication to instrument manufacturers may also be useful in decisions regarding development programmes.

I wish to thank Dr. J.P. van der Meulen, the CIMO Rapporteur on Instrument Development, who has prepared this excellent report and the Royal Netherlands Meteorological Institute for its support of this undertaking. My thanks go also to all those who contributed the information by means of the completed questionnaires.



(Dr. J. Kruus)
President of the Commission
for Instruments and Methods of Observation

Contents

0. Summary

This publication reports on the results of the fifth edition of the Instrument Development Inquiry. As stated in Res. 4 of CIMO-X, the Commission for Instruments and Methods of Observation (CIMO) had decided to circulate to all W.M.O. Members a new questionnaire on instrument development. A total number 143 completed questionnaires from 23 countries were returned. In this questionnaire a choice could be made between:

(1) Instrument under development, and
(2) Instrument put into operational use in recent 4 years

Although ten recipients ticked both boxes related to (1) and (2), it was possible to classify the returned questionnaires in both groups. The questionnaire also asked to indicate the category-of-measurement number to which the (to be) developed instrument belongs. Eighteen possibilities were put on the List of Categories (like Measurement of atmospheric pressure, or temperature, etc.); after consultation with the president of CIMO it was decided to exclude six types of measurements or techniques which were involved in the previous inquiry. The reason for this was to eliminate overlap with other work on this matter. The categories which were left outside the scope of the questionnaire are:

12. Measurement of upper wind
13. Radiosonde techniques
14. Meteorological balloon techniques
18. Meteorological observations from aircraft
19. Meteorological rocket sensing
20. Lower tropospheric sounding

The questionnaire included for the first time a request for background information on the motives of the development. It may be stated that there is a significant trend in the policy to do future instrument development: the impact of this activity in any long term plan will depend on the principle motives behind the need of further development.

It should be noted that there was a strong increase in the number of replies: 143 replies for this edition implies an increase of 20% with respect to the previous edition of the Instrument Development Inquiry (Fourth Edition, Instruments and Observing Methods Report No. 24, 1987, WMO/TD - No. 231). Obviously there still is an increasing need to develop new meteorological measuring and data-acquisition devices.

In this report, after a short introduction, a number of figures and tables are presented which are a result of the analysis of the entries. In the last two chapters the replies are presented, divided into instruments under development and instrument put into operational use. Finally, the questionnaire is attached to this report as an appendix.

1. Introduction

1. Background

The World Meteorological Organization has recognized the challenge of scientific and technological advances as a major influence of the World Weather Watch Programme. Consequently, the Instruments and Methods of Observation Programme (IMOP), an important component of the Third WMO Long-Term Plan (TLTP), concerns itself with a number of specific objectives on this matter. To attain these objectives a number of projects are defined with specific tasks; one of these projects is:

> Project 16.3 - New developments and automation: To prepare guidance material on new instruments and methods of observation to facilitate their selection and introduction into operational use.

It is stated in the TLTP that the W.M.O. Commission for Instruments and Methods of Observation (CIMO) will play a leading role in the realization of the IMOP programme. Because of this and, taking into account:

(1) The importance of previous inquiries on instrument development as guidance for improving sensors and automated observing systems,
(2) The need for technology transfer among members,
(3) The wide range of requirements for meteorological variables to be measured,

CIMO has decided at its tenth meeting (CIMO-X) to

(a) To update and solicit response(s) to the questionnaire on instrument development, maintaining its existing structure but taking into account new development and technology;
(b) To analyze the replies and to prepare a report for publication in the Instrument and Observing Methods Report series.

CIMO-X has appointed a rapporteur (the author of this report) to carry out these tasks (Res. 4, CIMO-X).

2. Organization

In November 1992 a request to complete the questionnaire was distributed to all W.M.O. Members to be returned before 1 January 1993 (see Appendix A for a copy of this questionnaire). Most of the replies were received by the rapporteur before March 1993, but the latest reply was received in June 1993. Therefore the state-of-development for all instruments under development, indicated in the questionnaire may be dated as 1 January 1993.

All replies were entered into an database on an IBM-compatible PC. The data entries were selected, sorted and presented in Chapter 3 of this report. In Chapter 3, paragraph 1, all replies concerning instruments under development are presented, whereas in paragraph 2 of that Chapter the

replies on instruments put into operational use are presented. For each of both classes, the replies are sorted out over 19 categories.

The questionnaire contained a number of questions concerning principle of operation and technology, the main technical characteristics, experiences and financial aspects. An overview of these questions is given below:

General information requests:

1. Short identification of the instrument including the parameter measured, or its function
2. State of development, or first year of operational use
3. Principle of operation
4. Main technical characteristics:
   - 4.1 application
   - 4.2 measuring range
   - 4.3 uncertainty
   - 4.4 time constant
   - 4.5 averaging time
   - 4.6 reliability
   - 4.7 interface and output details
   - 4.8 power requirements
   - 4.9 servicing interval
   - 4.10 other characteristics

Experiences and other information:

5. Experience from comparisons and tests performed
6. Costs, preferably in US$. For instruments under development, please enter estimated costs,
   - 6.1 unit cost at factory
   - 6.2 annual operating costs
7. Name and address of person responsible for further information (Name, Address, Telefax)
8. Major bibliographic references, applicable patents, etc.

Because the replies are entered into a database, it is possible to obtain easily these data as a computer file. Members who are interested to obtain such a file are kindly invited to contact the author of this report:

dr Jitze P. van der Meulen,
Royal Netherlands Meteorological Institute
Instrumentation division,
Postbus 201
3730 AE De Bilt, Netherlands.
tel.: +31 30 206432
fax : +31 30 210407
e-mail: vdmeulen@knmi.nl (internet)

The most convenient format will be in WordPerfect 5.1 "Mailmerge secondary source" on a MS-DOS formatted diskette, but other formats are also available.

3. Response

In Chapter 3, results of statistical analysis are presented: Number of entries per country, per category, classification of the status, *i.e.* under development or put into operational use, and classification of motives.

A list of 23 Members, who returned completed questionnaires related to systems (operational or under development) is given in the table below. In this table also the number of items is indicated:

State / Territory	**number**
Brazil	1
Canada	8
China	8
Finland	11
France	16
Germany	37
Hong Kong	3
Japan	2
Republic of Korea	1
Malaysia	1
Morocco	1
Netherlands	5
Norway	1
New Zealand	3
Poland	5
Russian Federation	12
Spain	1
Switzerland	3
Sweden	2
Tunisia	7
Thailand	4
United States of America	2
United Kingdom of Great Britain and Northern Ireland	9

4. Items for classification

The following types for classification were involved:

I. Classification of the status of the instrument/system:

(1) Instrument under development
(2) Instrument put into operational use

II. Categorization, based on a "List of Categories", with identical numbering as in the CIMO-Guide (WMO No. 8). The following categories were possible:

1. General (pertaining to general requirements of meteorological

stations)
2. Weather observations (techniques of observation)
3. Measurement of atmospheric pressure
4. Measurement of temperature
5. Measurement of humidity
6. Measurement of surface wind
7. Measurement of precipitation
8. Measurement of evaporation
9. Measurement of radiation
10. Measurement of visibility
11. Cloud observations
15. Observation of atmospherics
16. Instruments and observations at aeronautical meteorological stations
17. Marine observations
21. Measurement of sunshine duration
22. Automatic meteorological stations
23. Soil moisture measurements
24. Measurement of atmospheric composition, toxic chemicals and radioactive substances
0. Other

To eliminate overlap with work to be done by other CIMO rapporteurs or working groups it was decided after consultion with the President of CIMO to focus on surface measurements only. As a consquency the following items where left outside the questionnaire: 12. Measurement of upper wind, 13. Radiosonde techniques, 14. Meteorological balloon techniques, 18. Meteorological observations from aircraft, 19. Meteorological rocket sensing, and 20. Lower tropospheric sounding. Notice that these items were in the previous inquiry (fourth ed.). Other items which are not typically indicated in the list are: Road weather, icing, measurement of the freezing point and measurements typically useful for numerical weather prediction NWP).

5. Motivation

With regards to the previous inquiry a new question was added concerning the motives behind the instrument development, to be considered as background information. The following motives were suggested beforehand:

(1) Cost effectiveness (initial or operational)
(2) Automation of manual observation
(3) New type of observation
(4) Improved reliability or accuracy
(5) Less maintenance

In Chapter 2 results are presented concerning this question. Moreover a relatively large number of alternative motives are given in that Chapter.

2. Analysis

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1. Introduction

In part one of the questionnaire, "A. Classification" (see App. A for details), it was requested to indicate 1) the status of the development (under development or recently put into operational use), 2) the category number and 3) the motive of the development. Off course also the name of the country has to be indicated. As a result it is possible to perform statistics concerning these items. Results of this statistical analysis will inform about the current trend in instrument development and its motives. In this Chapter the results of these statistics will be presented as figures. Moreover typical categories and motives, as well as popular technologies and mayor conclusions are presented at the end of this Chapter. The detailed replies from the questionnaire are placed in Chapter 3.

2. Results

2.1. Number of entries per State/Territory

From 23 Members a total amount of 143 completed questionnaires were received. In fig. 1 an overview of these countries is presented together with there amount of entries. In this figure an indication is given of the status of the development (operational/under development, see next par.)

2.2. Classification of the entries

The total amount of the 143 entries can be divided over two types of classes: "Under development" and "Operational":

(1) Instrument under development . . . . . Amount: 65
(2) Instrument put in operational use in recent 4 years . Amount: 78

For 9 entries in class (1) it was indicated that the instrument was still under development but that an earlier type was put into operational in the recent 4 years; for 1 entry of class (2) it was indicated that the instrument was put into operational use but that developments were still going on. For convenience a so-called pie slice diagram is presented in fig. 2. Obviously the number of instruments put into operational use is somewhat larger the instruments under development (55% versus 45%).

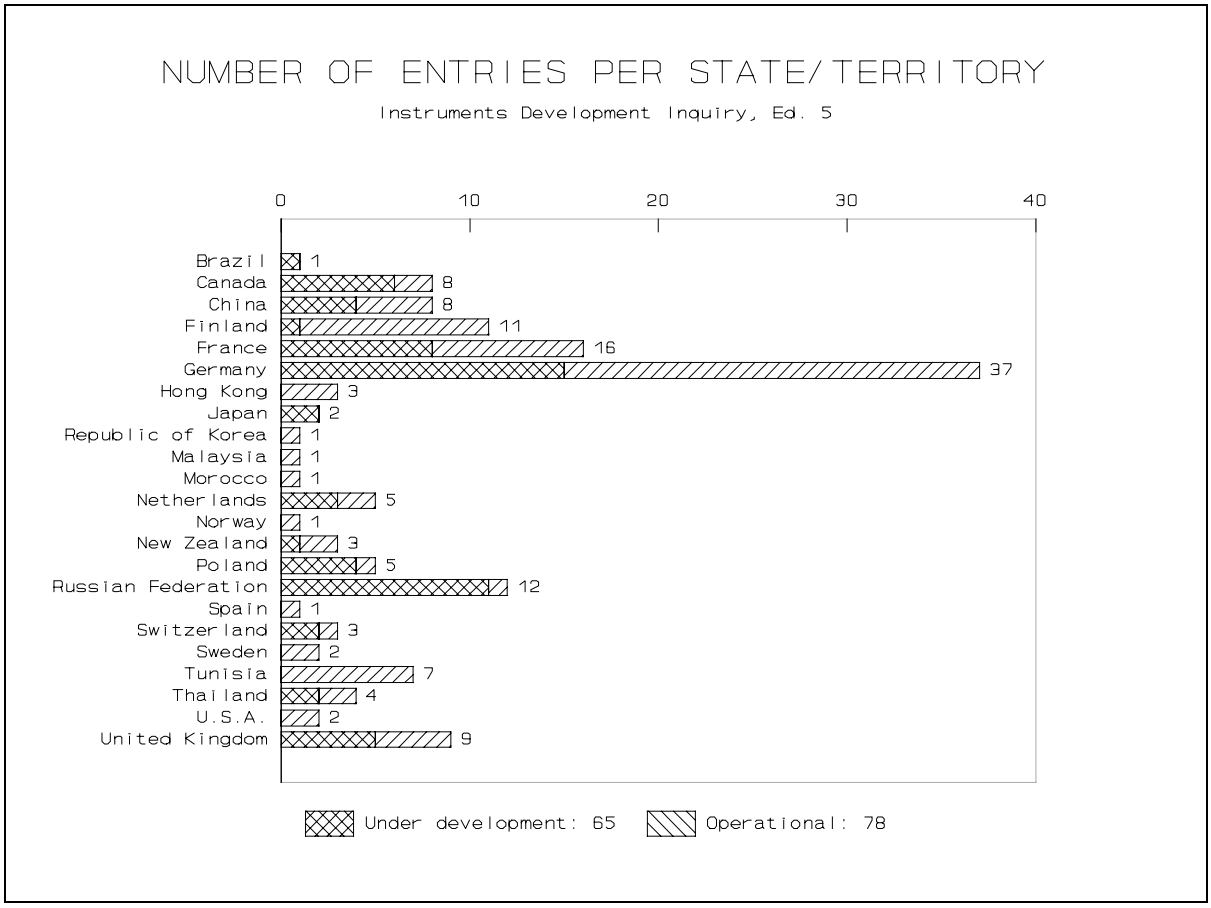

Fig. 1 Number of entries per State/Territory

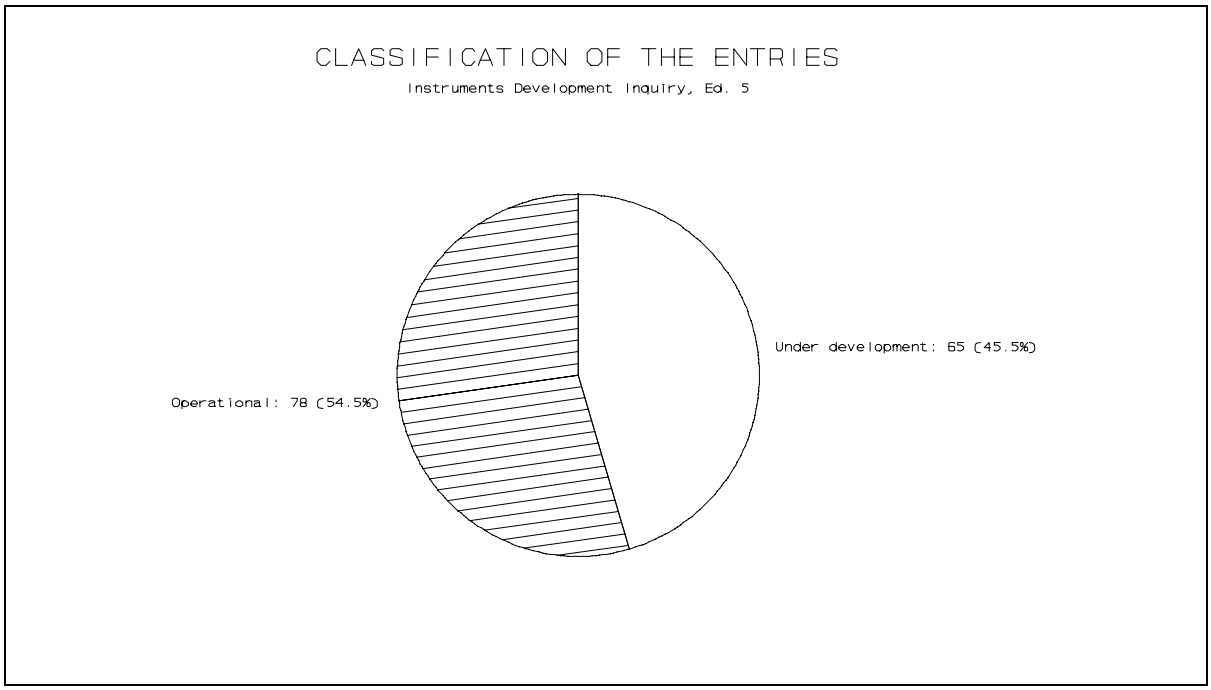

Fig. 2 Classification of the entries

2.3. Number of entries per category

In the questionnaire space was left to indicate more than one category from the *List of Categories*. Therefore each entry will refer to one or more than one category. As a consequence the total amount of categories referred to from the whole set of completed questionnaires is much larger than 143. In table 1 a matrix is presented indicating the total number of entries per category and per country. The number in square brackets represents the amount of instruments of the total number of instruments for this category which were put into operational use recently, *i.e.:*

"total number" ["number of operational instruments"]

In fig. 3 a general overview is given for the distribution of all entries over the categories:

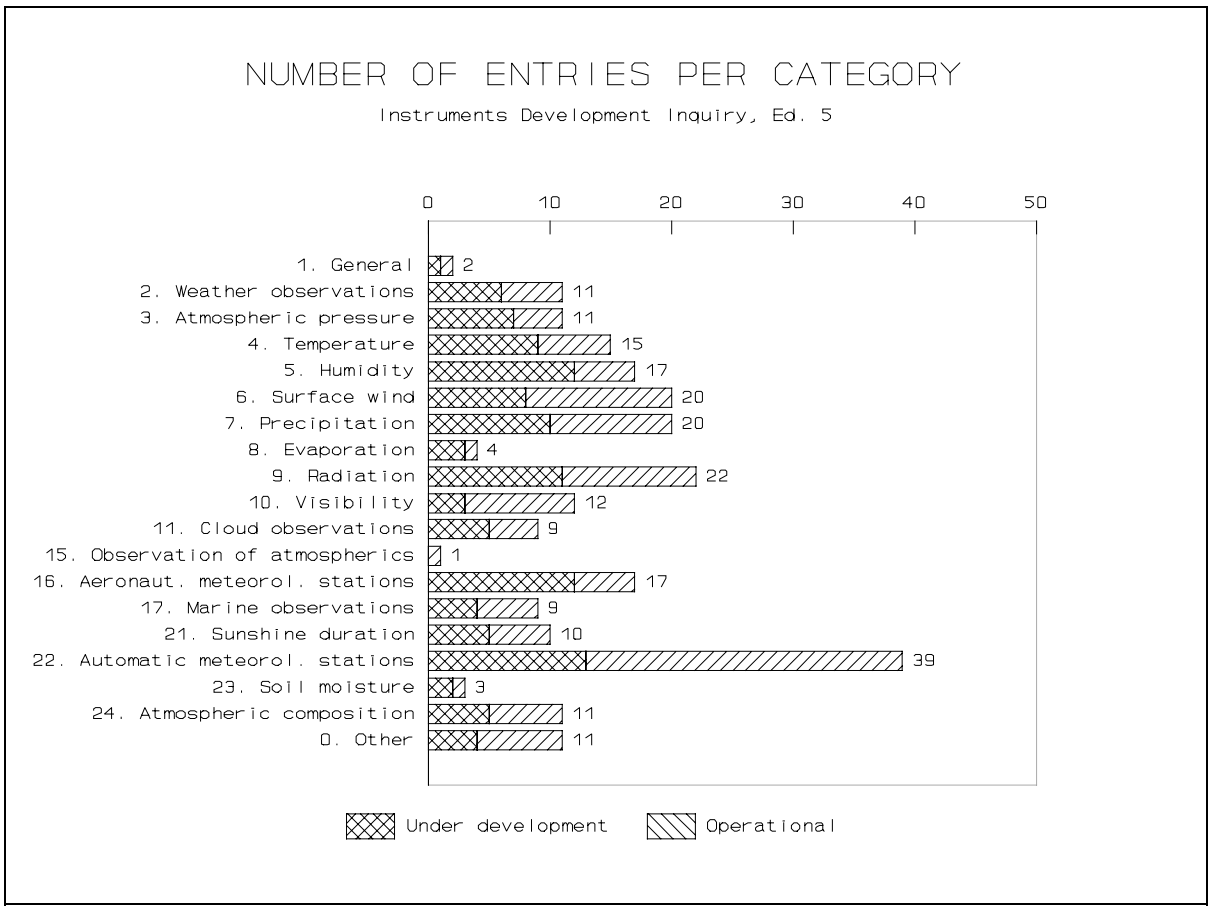

Fig. 3 Number of entries per category

Two typical categories, indicated as "0. Other" were "Icing" and "Freezing point measurements". From this diagram it is clearly demonstrated that the development of *automatic stations* (Synoptical, climatological or aeronautical) is far out the most popular item (cat. 22 and 17). Other categories which are currently in the picture are: 9. Measurement of radiation, 6. Measurement of surface wind and 7. Measurement of precipitation.

COUNTRY / CATEGORY	1	2	3	4	5	6	7	8	9	10	11	15	16	17	21	22	23	24	0
Brazil																1			
Canada			1				3		1	1	1		1	2 [2]	1	3 [2]			1
China			2 [2]	2 [2]	2 [2]	3 [3]	3 [3]		5 [2]							1 [1]	1		
Finland		1 [1]	2 [1]	1 [1]	1 [1]		2 [2]		1 [1]	3 [3]					1 [1]	1 [1]			1 [1]
France		4 [1]		1		2 [1]			3 [2]	3 [3]	1	1 [1]	1			5 [2]			2 [1]
Germany	1	1 [1]		1 [1]	2	7 [6]	3 [1]	1 [1]	8 [4]	2 [1]	1 [1]				4 [3]	8 [7]		9 [5]	4 [3]
Hong Kong		1 [1]					1 [1]			1 [1]	1 [1]					2 [2]			
Japan				1		1	1												
Republic of Korea																1 [1]			
Malaysia						1 [1]													
Morocco			1 [1]							1 [1]			1 [1]		1 [1]	1 [1]			
Netherlands				1	3	1			3 [2]									1	
Norway														1 [1]		1 [1]		1 [1]	
New Zealand		1											1 [1]	1 [1]		2 [1]			1 [1]
Poland				1		1		1								2 [1]			1
Russian Federation			3	3	6 [1]		1						9	4	1	4			
Spain		1 [1]														1 [1]			
Switzerland				1 [1]	1 [1]	1			1										
Sweden							2 [2]									1 [1]			1 [1]
Tunisia				1 [1]			1 [1]				1 [1]		1 [1]			2 [2]	1 [1]		
Thailand		2	2	2	2	2	2	2		1	1		2 [2]		2		1		
U.S.A.						1 [1]					1 [1]								
United Kingdom	1 [1]						1				2		1	1 [1]		3 [2]			
Total	2 [1]	11 [5]	11 [4]	15 [6]	17 [5]	20 [12]	20 [10]	4 [1]	22 [11]	12 [9]	9 [4]	1 [1]	17 [5]	9 [5]	10 [5]	39 [26]	3 [1]	11 [6]	11[7]

Table 1. Frequency of categories indicated per country; within square brackets: the number of entries for operational instruments only

Category Index:

1. General
2. Weather observations
3. Measurement of atmospheric pressure
4. Measurement of temperature
5. Measurement of humidity
6. Measurement of surface wind
7. Measurement of precipitation
8. Measurement of evaporation
9. Measurement of radiation
10. Measurement of visibility
11. Cloud observations
15. Observation of atmospherics
16. Instruments and observations at aeronautical meteorological stations
17. Marine observations
21. Measurement of sunshine duration
22. Automatic meteorological stations
23. Soil moisture measurements
24. Measurement of atmospheric composition, toxic chemicals and radioactive substances
0. Other

In the questionnaire it was not requested to classify the typical technologies use by the instruments. Nevertheless it was possible to identify from the more detailed questions of part B of the questionnaire that especially *optical technologies* are runners up: Optical techniques are involved in the measurements of radiation, cloud observations, present weather observations, humidity, precipitation, visibility, sunshine duration and atmospheric composition.

2.4. Motivation aspect

For background information a question was placed on the motives of the development. On forehand five typical motives were suggested: 1. Cost effectiveness (initial or operational), 2. Automation of manual observation, 3. New type of observation, 4. Improved reliability or accuracy, and 5. Less maintenance. It was also possible to indicate other motives. In fig. 4 a general statistical overview is given of the replies concerning this item. Note that more than one motive might been given, so the total numbers is larger than the total amount of completed questionnaires.

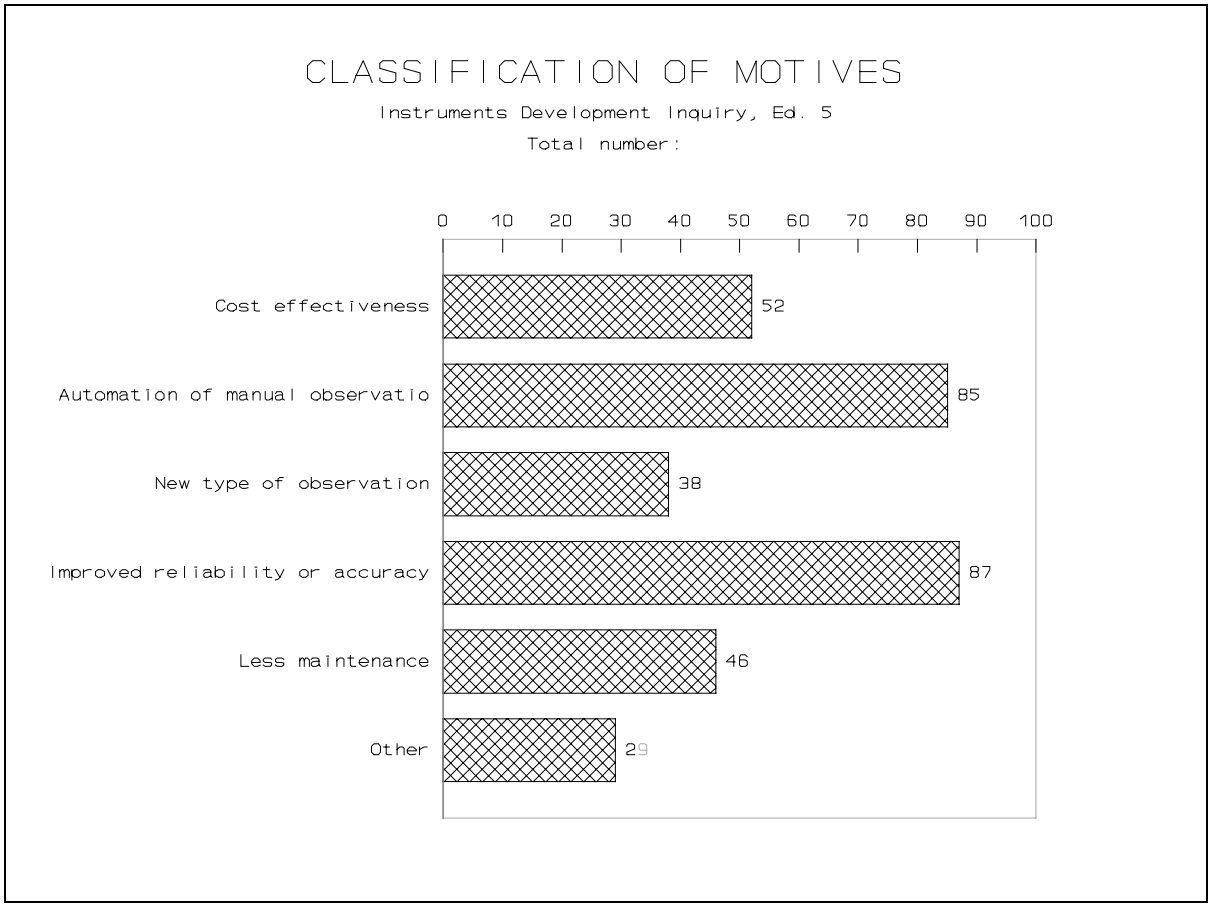

Fig. 4. Classification of motives

A relatively large amount of other motives was given as well:

- To obtain regular and consistent data from data sparse marine regions
- Improved long-term stability

- Flexibility with respect to the number of connections
- To be adapted to road weather meteorology
- Normalisation of interfacing
- Larger vertical range; high spatial and temporal resolution
- Extended range; major improvement of performance
- Application in a monitoring network at a high alpine station
- Wind measurement on sites with ice accretion
- Less power consumption
- Adjustable response
- Easy to operate automatic station
- Difficulty with obtaining spares for the old system
- Absence of mercury
- Use in unmanned stations
- Better coverage of low and high speeds in all conditions
- Problems under difficult conditions (winter/mountains)
- Different models for specific applications.
- Manual Entry Automatic Coding and Transmission of Reports FM12
- Manual / Semi-Automatic /Automatic Operation
- Wind display to meet CAP.573 requirement

Clearly two typical arguments are the basic motives for instrument development:

1. (2) Automation of manual observation,
2. (4) Improved reliability or accuracy.
3. (1) Cost effectiveness

It should be noticed that the following motive is less popular:

(3) New type of observation,

which implies that there is only minor interest in the meteorological community to discover new types of observation, which might be useful for meteorological or climatological purposes.

3. General conclusions

Based on the previous mentioned results the following conclusions may be drawn:

- A very large number of completed questionnaires were returned, 20% more than for the previous inquiry,
- Automation of Manual Observation, and Improved Reliability or Accuracy are the most important motives for initiating any instrument development.
- The most popular categories for which instruments or systems are developed are the categories concerning automatic data acquisition, processing and transmission: Automatic Weather Stations in combination with Aeronautical Meteorological Stations. Notice that the development for such systems is focused merely on interfacing of received information than on sensor technology.
- An important recognized technology used in new developed instruments is optics. Many developed sensors from many categories are based on optical techniques.
- To reduce maintenance or to increase reliability a number of wind measuring sensors/systems are indicated as "solid state, without moving

parts". Such systems do not have rotating cup anemometer or wind vanes any more. Most of them are based on the measurement of heat transfer or the displacement of "hot spots" caused by wind flow.

- The category "24. Measurement of atmospheric composition, toxic chemicals and radioactive substances" is well represented in 11 replies.
- Typical measurements outside the scoop not put into the list of categories: Icing, and Freezing Point Measurements.
- Especially "road weather" meteorology is mentioned as an application.

3. Information per entry in detail

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1. Instruments under development

1.1. General (pertaining to general requirements of meteorological stations):

-None-

Other entries related to this category: 1.9.7

1.2. Weather observations (techniques of observation)

Identification number: **1.2.1.** [37]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: The instrument, "Syresol", is designed to recognize the principal states of the ground (surface: Dry, humid, wet or covered with snow)
2. State of development: The research phase is completed. An industrial prototype will be realized.
3. Principle of operation: The working of the instrument is based on scattering and reflection of light, emitted by a projector, at the level of a reference plate installed on the surface.
4. **Main technical characteristics:**

4.1	application:	Automatic observation of the state of the surface
4.2	measuring range:	-
4.3	uncertainty:	-
4.4	time constant:	1 min
4.5	averaging time:	
4.6	reliability:	Very good
4.7	interface and output details:	RS 232 C line.
4.8	power requirements:	Electricity grid
4.9	servicing interval:	3 months
4.10	other characteristics:	The reference plate is made of black painted concrete. It is inserted into the ground to ensure the continuity of the surface.

Experiences and other information

5. Experience from comparisons and tests performed: Trouble free instrument which operates with a high reliability and delivering the principal states of the surface.
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	

7. Name and address of person responsible for further information:
   Gaumet, Jean-Louis
   SETIM/R.E.D.
   7 rue Teisserence de Bort

B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
Gaumet, J.L., P. Salomon and R. Paullissé: "Automatic Observations of the state of the Soil for Meteorological Observations", 7th Symposium of the AMS on Meteorological Observations and Instrumentation, (New Orleans, January 1991)

Identification number: **1.2.2.** [38]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: The instrument, "Smash", is designed to detect, to identify and to qualify the principal precipitating and suspending hydrometeors

2. State of development: The research phase is within sight of termination. An industrial prototype will be realized.

3. Principle of operation: The working of the instrument is based on scattering of light by hydrometeor particles, based on the same way as a visibility meter. It is an optical method and a statistical treatment is performed on a time series of signals.

4. **Main technical characteristics:**

4.1	application:	Automatic observations of present weather
4.2	measuring range:	
4.3	uncertainty:	approx. 10%
4.4	time constant:	approx. 4 min.
4.5	averaging time:	
4.6	reliability:	good
4.7	interface and output details:	RS 232 C line
4.8	power requirements:	Electricity grid
4.9	servicing interval:	3 months

4.10 other characteristics: The instrument has to be installed on an experimental site free from obstacles within a distance of ten meters across the case. In addition to the identification of the principal hydrometeors, it is capable to adjust the "visibility" transfer function with respect to the nature of the observed hydrometeor

Experiences and other information

5. Experience from comparisons and tests performed: The instrument is capable to identify suspended and precipitated hydrometeors (haze, mist, rain and snowfall). Haze and mist is quasi-systematic identified. Rain and snowfall is recognized in 90% of the cases.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Gaumet, Jean-Louis
SETIM/R.E.D.
7 rue Teisserence de Bort
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
   - Gaumet, J.L., P. Salomon and R. Paullissé: "Present Weather Determination by an Optical method", 7th Symposium of the AMS on Meteorological Observations and Instrumentation, (New Orleans, January 1991)
   - Gaumet, J.L., P. Salomon and R. Paullissé: "Automatic Observations of the state of the Soil for Meteorological Observations", 7th Symposium of the AMS on Meteorological Observations and Instrumentation, (New Orleans, January 1991)
   - Gaumet, J.L., P. Salomon and R. Paullissé: "Procedé d'identification automatique des hydrometeors" - Patent application for France No. 90 07 005.

Identification number: **1.2.3.** [40]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: This "Schuman" instrument is designed to detect, to identify and to quantify precipitating hydrometeors.
2. State of development: The research phase will be completed soon. The instrument will surely pass through industrial stage in 1993.
3. Principle of operation: The instrument uses a low power doppler radar transmitting continuously and vertically pointing. The speed of fall of the hydrometeors and their dispersion are used to determine the types of the hydrometeors
4. **Main technical characteristics:**

4.1	application:	Automatic observation of present weather.
4.2	measuring range:	
4.3	uncertainty:	10%
4.4	time constant:	Less than 1 min.
4.5	averaging time:	
4.6	reliability:	Excellent
4.7	interface and output details:	RS 232C line
4.8	power requirements:	220 V
4.9	servicing interval:	6 months
4.10	other characteristics:	The instrument is also capable to give an estimation of the amount of water.

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	< US$ 1,000

7. Name and address of person responsible for further information:

Duvernoy, Jerome
Météo France
SETIM R&D
7 rue Teisserence de Bort
B.P. 202
78195 Trappes CEDEX
France

Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
   - "Measurement of hydrometeor size distributions with a vertically pointing CW radar". 25th International Conference on Radarmeteorology, (Paris, France, 24-28 June, 1991)

- "Caractérisation du temps présent au moyen d'un radar Doppler pointé verticalement", TECO-92 (W.M.O.), (Vienna, Austria, 11-15 May, 1992)
- "Weather characterization by the mean of a vertically pointing CW radar", 8th Symposium on Meteorological Observations and Instrumentation, (Anaheim, USA, 17-22 january, 1993).

Identification number: **1.2.4.** [100]

Country: **New Zealand**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Weather Observing Terminal (WOT-2)
2. State of development: Prototype evaluation
3. Principle of operation: A MacIntosh computer with software written in 'Hypertalk', provides the User Interface to enter meteorological data and access to data from the local Automatic Weather Station.
4. **Main technical characteristics:**

4.1	application:	Production of standard meteorological reports.
4.2	measuring range:	N/A
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	N/A
4.7	interface and output details:	N/A
4.8	power requirements:	Computer requires mains power
4.9	servicing interval:	N/A
4.10	other characteristics:	The WOT-2 unit will provide a high level user interface for the entry of data and production of coded weather reports. The unit is responsible for managing the manual data input, providing assistance in making code selections, checking data validity, coding the reports and transmitting them to a central computer. the unit also provides access to a local Automatic Weather Station (AWS) if available. it can either automatically insert some of the data into reports or provide it as a prompt to an observer. Random access to AWS data via the unit is available.

Experiences and other information

5. Experience from comparisons and tests performed: N/A
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	N/A

7. Name and address of person responsible for further information:
   Abbott, Kenneth
   Meteorological Service of New Zealand Limited
   P.O. Box 722
   Wellington
   New Zealand
   Telefax: +64 4 473 5231
8. Major bibliographic references, applicable patents, etc.:
   -

Other entries related to this category:
1.21.3,
1.21.4

1.3. Measurement of atmospheric pressure

Identification number: **1.3.1.** [5]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function: Remote Video observing system.
2. State of development: Being evaluated operationally. A pan tilt and zoom capability being developed. User software being improved. Operational usefulness to be verified.
   first year of operational use: 1992
3. Principle of operation: Commercial Video Technology combined microcomputer processing and display
4. **Main technical characteristics:**

4.1 application: To monitor weather.
4.2 measuring range: Visual.
4.3 uncertainty:
4.4 time constant:
4.5 averaging time: Instantaneous
4.6 reliability: To be determined
4.7 interface and output details: Data transmitted from microcomputer (pc) to pc using data compression, 9600 baud modem and telephone lines.
4.8 power requirements: 110 V AC
4.9 servicing interval: Site dependent, to be determined
4.10 other characteristics:

- For daylight observations only
- Performance dependant on weather conditions
- One to four fixed focal length CCD Video Cameras used.

Experiences and other information

5. Experience from comparisons and tests performed: Unpublished internal reports. Used by forecasters to verify weather at remote locations.
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: Site dependent

7. Name and address of person responsible for further information:
   Sadubin, Jack
   AES, Bedford
   Canada
   Telefax: 902-426-9158
8. Major bibliographic references, applicable patents, etc.:

Identification number: **1.3.2.** [26]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: PTB 100 Analogue barometer
2. State of development: Available on June 1993
   first year of operational use: 1993
3. Principle of operation: Silicon capacitive absolute pressure sensor. All analogue signal conditioning electronics.

4. **Main technical characteristics:**

4.1 application: AWS pressure transmitter

4.2 measuring range: 800 - 1060 hPa/600 - 1060 hPa

4.3 uncertainty: (Total accuracy) ± 0.3 hPa/20°C; ± 1 hPa/—40 - +60°C

4.4 time constant: Setting time 500 ms

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: 0 - 5 V DC/0 - 2.5 VDC, 3- or 4-wire connection

4.8 power requirements: 8 - 30 V DC, 4 mA

4.9 servicing interval: Stability check once a year

4.10 other characteristics:

- Long term stability < ± 0.1 hPa/year
- Linearity < ± 0.2 hPa
- Power supply triggering possibility with TTL level logic signal
- Offset adjustment using fine adjustment potentiometer allowed for the user
- Traceability to NIST, USA

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Järvi, Pekka
Vaisala Oy
PL 26
SF-00421 Helsinki,
Finland

Telefax: +358-0-8949485

8. Major bibliographic references, applicable patents, etc.:
Many patents on silicon capacitive pressure sensor technology and on capacitive measurement techniques

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Identification number: 1.3.3. [108]

Country: Russian Federation

General information

1. Short identification of the instrument including the parameter measured, or its function:
Meteorological station barometer (BSM): Measures atmospheric pressure in various climatic zones

2. State of development:

3. Principle of operation: Compensation for the force of atmospheric pressure acting on an evacuated bellows-type box connected to the short first-order lever arm by weights fixed to the end of the long lever arm and the weight of the carriage moving along this arm; machining of parts

4. **Main technical characteristics:**

4.1 application: Measurement of atmospheric pressure

4.2 measuring range: 600 - 1070 hPa

4.3 uncertainty: ±0.3 hPa

4.4 time constant:

4.5 averaging time: 2 min.

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: None
4.9 servicing interval: 1 year
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 1.3.4. [114]

Country: Russian Federation

General information

1. Short identification of the instrument including the parameter measured, or its function:
Operational network barometer for measuring atmospheric pressure

2. State of development: Government acceptance testing done and instrument production mastered. Operational testing of the experimental part on the Roskomgidromet network

3. Principle of operation: Measures pressure using a vibrator cylinder; incorporated microprocessor does processing, temperature correction and output of results on the display panel and sequential channel

4. **Main technical characteristics:**

4.1 application: Atmospheric pressure measurements. Autonomous instrument; sensor used at aerodromes and manned network stations
4.2 measuring range: 600 - 1100 hPa; resolution: 0.01 hPa
4.3 uncertainty: Maximum permissible error: ±0.3 hPa in temperature range 5°C - 50°C.
4.4 time constant:
4.5 averaging time:
4.6 reliability: 10 000 h MTBF
4.7 interface and output details: Output signal - sequential code
4.8 power requirements: Mains 220 V, 50 Hz
4.9 servicing interval: Interval between servicing: 3 years
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Solomon, Persin
Karbysheva Str. 7
194018 Saint Petersburg
Russian Federation

Telefax: +7-812-2478661

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.3.5.** [115]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Digital sensor of atmospheric pressure

2. State of development: 1992: Inter-institutional testing; 1993: Operational use in the Main Geophysical Observatory (Saint Petersburg)

3. Principle of operation: Measures pressure using a vibrator cylinder. An incorporated microprocessor does the processing, temperature correction and output of resultant digital data on the sequential duplex channel.

4. **Main technical characteristics:**

4.1	application:	Measurement of atmospheric pressure: Sensor for unmanned stations and for use in difficult operating conditions.
4.2	measuring range:	600 - 1100 hPa; resolution: 0.01 hPa
4.3	uncertainty:	Maximum permissible error ±0.5 hPa in temperature range ±50°C
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	50 000 h MTBF
4.7	interface and output details:	Output signal - sequential code
4.8	power requirements:	15 V, 0.05 A; —15 V, 0.04 A; 5 V, 0.45 A
4.9	servicing interval:	Interval between servicing: 2 years

4.10 other characteristics:
- Mass: not more than 1 kg,
- Dimensions: 200 × 110 × 40 mm

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Solomon, Persin
Karbysheva Str. 7
194018 Saint Petersburg
Russian Federation
Telefax: +7-812-2478661

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
1.21.3
1.21.4

1.4. Measurement of temperature

Identification number: **1.4.1.** [31]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Radiometer - it measures the surface radiation temperature.
2. State of development: Feasibility study, Demonstrator, Evaluation of the precision. Availability 2nd quarter 1994.
3. Principle of operation: Thermic Infrared multiwave Radiometer. The instrument determines the temperature and the emissivity of the surface in focus.
4. **Main technical characteristics:**

4.1	application:	State of the surface - road weather
4.2	measuring range:	—30°C - 70°C
4.3	uncertainty:	0.1°C (reference instrument), 0.3°C (network type)
4.4	time constant:	2 seconds
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	Digital output - message
4.8	power requirements:	Possibly autonomous (solar energy)
4.9	servicing interval:	1 year
4.10	other characteristics:	Today there is no thermic infrared radiometer on the market with respect to precision, self supporting, continuous working outdoor and without dazzling by sunlight or by intens sources outside the analyzed spectrum. The new radiometer will take these constraints into account and allows without ambiguity the measurement of the surface temperature and emissivity with respect to the site conditions. As a consequence it allows to determine the characteristics of the state of the surface with a good success rate.

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	US$ 200 - 1000

7. Name and address of person responsible for further information:
   CIMEL ELECTRONIQUE
   5, Cité de Phalsbourg
   75011 Paris,
   France
   Telefax: (33) 1 43.48.62.61
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **1.4.2.** [101]

Country: **Poland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Meteorological temperature column, a measuring device for all kinds of temperatures: Soil, ground, dry bulb, wet bulb, upper level, etc. Instantaneous values every 15 min. and extreme day and night values.
2. State of development: Prototyp, laboratory tests finished

3. Principle of operation: Pt-100 thermometers in special circuits, microprocessor (EPROM 4 kB, RAM 2 kB) based processing and transmitting units, specialized digital indicator.

4. **Main technical characteristics:**

4.1	application:	Temperature measurements for research and meteorological service
4.2	measuring range:	—35°C - +45°C
4.3	uncertainty:	± 0.1°C
4.4	time constant:	10 s
4.5	averaging time:	-
4.6	reliability:	Not available
4.7	interface and output details:	Specialized microprocessor based digital indicator
4.8	power requirements:	50 W
4.9	servicing interval:	Not available
4.10	other characteristics:	Distance between sensors and display: Up to 1 km

Experiences and other information

5. Experience from comparisons and tests performed: Not available

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Not available

7. Name and address of person responsible for further information:

Różdżyński, Kazimierz
Sędzickiego 13
81-384 Gdynia
Poland

Telefax:

8. Major bibliographic references, applicable patents, etc.:
Memo only

Other entries related to this category:

1.5.5
1.5.6
1.5.8
1.6.4
1.7.5
1.21.3
1.21.4

1.5. Measurement of humidity

Identification number: **1.5.1.** [56]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: LiCl hygrometer with status indication. Indirect heating, SMD electronic
2. State of development: Start of production IV/93
3. Principle of operation: Measurement of the equilibrium vapour pressure of a LiCl solution. Prevention of electrolytic decomposition and reduction of influence of ventilation rate.
4. **Main technical characteristics:**

4.1	application:	Automatic Weather Station
4.2	measuring range:	Dewpoint t_d = —25 ... +50 °C
4.3	uncertainty:	t_d: ± 0.2 K
4.4	time constant:	≈ 1 min
4.5	averaging time:	adjustable
4.6	reliability:	± 0.2 K within service interval
4.7	interface and output details:	Outdoors protection screen required
4.8	power requirements:	12 V DC, 0.7 VA
4.9	servicing interval:	> 6 months

4.10 other characteristics:
- measurement of vapour pressure with high concentration of aggressive compounds
- measurement of humidity of technical gases in trace range

Experiences and other information

5. Experience from comparisons and tests performed: Accuracy certificate issued by PTB Berlin pending
6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Janssen, Dr. Heino
Wilh. Lambrecht GmbH
P.O.B. 26 54
Friedländer Weg 65-67
D-3400 Göttingen
Telefax: 551-49 58 12

8. Major bibliographic references, applicable patents, etc.:
Patent No. 4034185, "Vorrichtung zur Messung des Wasserdampfpartial-druckes", reg. 26.10.1990, publ. 30.04.1992

Identification number: **1.5.2.** [92]

Country: **Netherlands**

General information

1. Short identification of the instrument including the parameter measured, or its function: Low cost, full calibrated and interchangeable humidity sensor, capacitance type.
2. State of development: Full production start-up tests, zero series available
3. Principle of operation: Capacitance type sensor that will be calibrated during production

4. **Main technical characteristics:**

4.1	application:	Relative humidity
4.2	measuring range:	Rel. humidity: 0 - 100 %RH, temperature: —40 - +80°C
4.3	uncertainty:	= calibration error
4.4	time constant:	6 minutes (90%)
4.5	averaging time:	
4.6	reliability:	Long term stability
4.7	interface and output details:	to be developed separate
4.8	power requirements:	N/A
4.9	servicing interval:	N/A
4.10	other characteristics:	Linear response to relative humidity over the full range

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	N/A

7. Name and address of person responsible for further information:

Schmitz, Paul
Flucon B.V.
Kalkhovenweg 54
2401 LK Alphen a/d Rijn
Netherlands

Telefax: (+31) (0)1720-22271

8. Major bibliographic references, applicable patents, etc.:
Patent 909010431 Europe, Priority NL/8803223, Designated states: AT, BE, CH, LI, DE, ES, FR, GB, IT, LU, NL, SE; Norway 000912492, Canada 020069481, Denmark 000125891, Finland 000913165, USA SN 720430, Japan 502194/90

Identification number: **1.5.3.** [94]

Country: **Netherlands**

General information

1. Short identification of the instrument including the parameter measured, or its function: Fast response humidity and carbondioxide sensor for measuring the vertical fluxes of water vapour and carbondioxide.

2. State of development: A prototype has been used at several measuring campaigns. More, upgraded instruments are under construction

3. Principle of operation: Absorbtion of infrared radiation in an open measuring cell.

4. **Main technical characteristics:**

4.1	application:	Measurement of H_2O and CO_2 fluxes near the surface.
4.2	measuring range:	H_2O: 0 - 20 gm^{-3}, CO_2: 0 - 500 ppm
4.3	uncertainty:	The sensitivity is for H_2O: 0.02 gm^{-3} and for CO_2: 0.4 ppm. The uncertainty is typically 10 times above these values.
4.4	time constant:	0.1 s
4.5	averaging time:	N/A
4.6	reliability:	Not enough experience yet
4.7	interface and output details:	Analogue output in terms of H_2O and CO_2 concentration
4.8	power requirements:	100 W

4.9 servicing interval: Not well established

4.10 other characteristics: The instrument differs from comparable devices by the use of optical fibers, thus reducing the size of the measuring cell to a minimum. In this way the disturbance of the wind by the presence of the instrument is kept as small as possible. The sensor is used in conjunction with a sonic anemometer.

Experiences and other information

5. Experience from comparisons and tests performed: N/A

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:

Kohsiek, William
Royal Netherlands Meteorological Institute
P.O. Box 201
3730 AE de Bilt,
the Netherlands
Telefax: (+31) (0)30 210 407

8. Major bibliographic references, applicable patents, etc.:

Kohsiek, W. (1991): "Infrared H_2O/CO_2 sensor with fiber optics", Proceed. Seventh AMS Symposium on Meteorological Observations and Instrumentation, New Orleans, LA, U.S.A., Jan. 13-18, 1991

Identification number: 1.5.4. [106]

Country: Russian Federation

General information

1. Short identification of the instrument including the parameter measured, or its function:
Thermohygrometer PR-63: Measures temperature, dewpoint and relative humidity.

2. State of development:

3. Principle of operation: Use of electrolyte temperature stabilization during triple-point pre-heating; coiling of conductors on an isolated rod and application of the electrolyte solution

4. **Main technical characteristics:**

4.1 application: Single measurement of temperature and dew point at low temperatures and computation of relative humidity.

4.2 measuring range: Dew point: from —40°C to +32°C at temperatures from —25°C to +50°C

4.3 uncertainty: ±0.5°C in saturation conditions

4.4 time constant: 0.5 min

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: Digital output via signal panel on emitter diodes

4.8 power requirements: Accumulator

4.9 servicing interval: 1 year

4.10 other characteristics: Can operate in uninterrupted or interruptable mode

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.5.5.** [107]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function: DT M-141 sensor for thermohygrometers and for temperature and dewpoint measurement channels in measuring systems

2. State of development:

3. Principle of operation: Use of electrolyte temperature stabilization during triple-point preheating; manufactured using thin-film technology

4. **Main technical characteristics:**

4.1	application:	Measurement of dew point and temperature.
4.2	measuring range:	Dew point: from —30°C to +32°C; temperature: from —25°C to +100°C
4.3	uncertainty:	0.5°C of dew point in saturation conditions
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	
4.8	power requirements:	DC source: Accumulator or battery
4.9	servicing interval:	1 year
4.10	other characteristics:	Can operate in uninterrupted or interruptable mode

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.5.6.** [110]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function: Dew point sensor "Toros" for hygrometers and dew-point measurement channels in measuring systems
2. State of development:
3. Principle of operation: Use of electrolyte temperature stabilization during triple-point preheating; coiling of conductors on an insulated rod and application of the electrolyte solution
4. **Main technical characteristics:**

4.1 application: Measurement of dewpoint in land and sea conditions
4.2 measuring range: From —30°C to +32°C
4.3 uncertainty: ±0.5°C in saturation conditions
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details: Resistance to direct current: 80 - 140 Ω.
4.8 power requirements: DC source (accumulator or battery): —27 V and +12 V
4.9 servicing interval: 1 year
4.10 other characteristics: Only operates in uninterrupted mode; remains operational in sea conditions (sea fog, spray, etc.)

Experiences and other information

5. Experience from comparisons and tests performed: Positive results obtained in operational work in marine conditions (on board ship)
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:
   Instrument R&D Institute
   Raskovoi Str. 20
   125124 Moscow
   Russian Federation
   Telefax:
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **1.5.7.** [112]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function: PR-62 sensor for thermohygrometers and for temperature and relative humidity measurement channels in measuring systems
2. State of development:
3. Principle of operation: Use of electrolyte temperature stabilization during triple-point preheating; coiling of conductors on an insulated rod and application of the electrolyte solution
4. **Main technical characteristics:**

4.1 application: Measurement of dew point and temperature
4.2 measuring range: Dew point: From —40°C to 32°C; temperature: From

		−25°C to +50°C
4.3	uncertainty:	±0.5°C of dew point in saturation conditions
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	
4.8	power requirements:	DC source: Accumulator or battery
4.9	servicing interval:	1 year
4.10	other characteristics:	Can operate in uninterrupted or interruptable mode

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation

Telefax:

8. Major bibliographic references, applicable patents, etc.:

-

Identification number: **1.5.8.** [113]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Relative humidity sensor

2. State of development: Undergoing government acceptance testing with the participation of Gosstandard and Roskomgidromet.

3. Principle of operation: Capacitance humidity-sensitive converter (humicap); included in the capacitance-to-frequency conversion scheme.

4. **Main technical characteristics:**

4.1	application:	RH measurements. Autonomous, remote meteorological hygrometers and automatic weather stations
4.2	measuring range:	1 - 100 %RH
4.3	uncertainty:	±3% RH (at 0°C < t < +50°C); ±5% RH (at −50°C < t < 0°C)
4.4	time constant:	2 min. with V ≥ 0.5 m/s (V = wind speed)
4.5	averaging time:	
4.6	reliability:	1000 h MTBF
4.7	interface and output details:	Output signal frequency: 3 - 7 kHz
4.8	power requirements:	12 V DC, 0.14 W
4.9	servicing interval:	At most once every six months
4.10	other characteristics:	

- Remote functioning up to 300 m
- mass < 150 g
- dimensions not greater than Ø 30 × 140 mm

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Solomon, Persin
Karbysheva Str. 7
194018 Saint Petersburg
Russian Federation
Telefax: +7-812-2478661

8. Major bibliographic references, applicable patents, etc.:
-

_____

Other entries related to this category:

1.6.4
1.21.3
1.21.4

1.6. Measurement of surface wind

Identification number: **1.6.1.** [44]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Anemometer sensors (contact free cups and windvane, with optical encoder) + set for transmission of wind information

2. State of development: Start of operational use: december 1992 (anemometer) and April/May 1993 (transmission set)

3. Principle of operation: Classic type of sensors - windvane with optical encoder - processing with respect to the sensor: averages, extremes, variability of the wind (force and direction) especially for aeronautics. Digital transmission. Immune for overstraining.

4. **Main technical characteristics:**

4.1	application:	Measurement of wind for synoptical purposes and/or on aeronautical sites
4.2	measuring range:	0.5 to 80 m/s
4.3	uncertainty:	± 2%, ± 0.5 m/s
4.4	time constant:	wind displacement constant = 3.5 m; decay factor: 0.3 (windvane)
4.5	averaging time:	Acquisition at all 500 m/s; average winds: 2' and 10'; variability: 10'
4.6	reliability:	Very quick answers
4.7	interface and output details:	Serial line via 1200 baud modem
4.8	power requirements:	Autonomous, without deicing option
4.9	servicing interval:	1 year
4.10	other characteristics:	The sensor disposes of its own power supply by solar energy which prevents the requirement of electrical energy with possible parasitic overstraining. The digital transmission by modems with an isolated transformer permits a completely isolation of the sensor outside.

Experiences and other information

5. Experience from comparisons and tests performed: A sensor participates to the WMO intercomparison of anemometers. Prototype validated. The sensors are put into operational use.

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Not yet being answered

7. Name and address of person responsible for further information:

Lafaysse, Christian
SETIM/QMR/ND
Météo France
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.6.2.** [78]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Measurement of wind speed component by measuring the force on a sphere
2. State of development: Ready for tests in a wind channel and calibration
3. Principle of operation: The force of wind speed on a sphere is proportional to wind speed to the square, air pressure and to the cos. between wind speed and the sensitive direction of the sphere
4. **Main technical characteristics:**

4.1	application:	Cross wind at runways and bridges with one sensor; heavy wind speed and direction with two sensors.
4.2	measuring range:	Approx. 1 m/s to 100 m/s
4.3	uncertainty:	± 0.5 m/s at 2 m/s to < ± 0.01 m/s at 100 m/s
4.4	time constant:	None
4.5	averaging time:	By software; standard: 2 min. and 10 min.
4.6	reliability:	Very high; no moving parts
4.7	interface and output details:	
4.8	power requirements:	12 V DC, approx. 1 VA without heating (heating approx. 100 W)
4.9	servicing interval:	No service required
4.10	other characteristics:	Calibration is long time stable (more than 5 years). Influence of pressure and temperature are calibrated and used for calculation of accurate wind velocity. Temperature range: —40°C (heated sphere) to +80°C. sensor and electronics are protected against lightnings.

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Energy only

7. Name and address of person responsible for further information:

Tiefenau, Dr. Helmut
c/o Albin Sprenger KG GmbH & Co.,
BOX 20
D-3424 St. Andreasberg,
Germany
Telefax: +5582-1038

8. Major bibliographic references, applicable patents, etc.:
German Patent G 91 15 727.7

Identification number: **1.6.3.** [87]

Country: **Japan**

General information

1. Short identification of the instrument including the parameter measured, or its function: Ice-resistant ultrasonic anemometer
2. State of development: Now under development. Field test will be made in the summer of 1993.
   first year of operational use: Not yet decided.
3. Principle of operation: Ultrasonic anemometer with heater

4. **Main technical characteristics:**

4.1 application: Meteorological station in mountainous area

4.2 measuring range: 0 - 60 m/s

4.3 uncertainty: Less than ±0.5 m/s at wind speed < 10 m/s, less than ±0.5% at wind speed > 10 m/s, less than ±10% at wind speed > 500 m/s; less than ±5 deg. wind speed 0.8 m/s

4.4 time constant: 0.1 second

4.5 averaging time: 10 minutes

4.6 reliability:

4.7 interface and output details: Analogue (0 - 5 V DC), Digital (RS 422) output

4.8 power requirements: 100 V AC, 50/60 Hz; 20 VA for electronics, 1500/2400 VA for heater

4.9 servicing interval:

4.10 other characteristics:

- Heating rate is automatically controled.
- The instrument has self-test function
- Both of averaged and instantaneous measurements are available

Experiences and other information

5. Experience from comparisons and tests performed: Maintenance-free operation is expected.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Nagasaka, Koichi
Senior assistant for International Affairs
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100,
Japan

Telefax: +81 3 3211 2032

8. Major bibliographic references, applicable patents, etc.:

-

Identification number: 1.6.4. [93]

Country: Netherlands

General information

1. Short identification of the instrument including the parameter measured, or its function:
Integrated Smart Sensor with Digital bus output for: Temperature, Humidity, Wind and Radiation.

2. State of development: From research till prototyping
first year of operational use: Planned: Temperature, 1994; wind, 1993; radiation, 1994

3. Principle of operation: Microelectronic devices capable to measure parameters on chip with smart electronics providing digital bus output on the same chip. Mass fabrication technology.

4. **Main technical characteristics:**

4.1 application: Wind flow measurements

4.2 measuring range: 0 - 40 m/s

4.3 uncertainty: Wind speed: 5%, direction: 2°

4.4 time constant: 1 sec.

4.5 averaging time:

4.6 reliability: No moving parts
4.7 interface and output details: Simple digital bus output is under development
4.8 power requirements:
4.9 servicing interval:
4.10 other characteristics: No moving parts

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Mierij Meteo
Tuinstr. 1-3
3732 VJ de Bilt,
Netherlands
Telefax: (+31) (0)30-204264

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 1.6.5. [102]

Country: Poland

General information

1. Short identification of the instrument including the parameter measured, or its function:
Universal PC anemometer, UMAS: Instananeous, averaged and maximum wind speed (2, 10 min.) - analog and digital; instantaneous and averaged wind direction - analog and digital; gust magnitude - digital; wind sector - analog

2. State of development: Short series, laboratory tests finished, field tests continuation
first year of operational use: 1992

3. Principle of operation: Heated cup anemometer and wind vane sensors, light chopper and Gray-code disc transducers (8 bit), RS 232C (300 baud) communication, IBM-PC computation, display: Monitor or specialized digital indicator

4. **Main technical characteristics:**

4.1 application: Wind speed en direction measurements at meteorological service for all purposes
4.2 measuring range: Wind speed: 0 - 50 m/s, wind direction: 0 - 360°
4.3 uncertainty: Wind speed: ± 2% FS, wind direction: ± 3°
4.4 time constant: -
4.5 averaging time: 2, 10 min.
4.6 reliability: Not available yet
4.7 interface and output details: IBM-PC or spec. digit. indicator
4.8 power requirements: 150 W + 2 × 300 W heating
4.9 servicing interval: not available
4.10 other characteristics:
Threshold: 0.8 m/s, velocity resolution: 0.1 m/s, non-linearity: 2%.
Distance constant for heated cup wheel: < 12 m, distance constant for common cup wheel: < 6 m.
Sampling interval for velocity: 2 s, sampling interval for direction: 10 s
Distance between sensors and display: Up to 2 km; lightning protection

Experiences and other information

5. Experience from comparisons and tests performed: not available yet

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: not available

7. Name and address of person responsible for further information:
Różdżyński, Kazimierz
Sędzickiego 13
81-384 Gdynia
Poland
Telefax:

8. Major bibliographic references, applicable patents, etc.:
Memo only

Identification number: **1.6.6.** [120]

Country: **Switzerland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Two orthogonal components of the wind speed are measured with one sec. resolution, based on the heat transfer of protected platinum wires.

2. State of development: Prototypes were operated for more than a year, first operational instruments are expected in 1993

3. Principle of operation: The heat transfer from platinum wires is measured to determine orth. windspeed. The wires are well protected from rain, snow and icing.

4. **Main technical characteristics:**

4.1 application: Wind measurement
4.2 measuring range: 0.2 - 100 m/s
4.3 uncertainty: 0.1 m/s ± 5%
4.4 time constant: 0.1 s max
4.5 averaging time: 1 sec
4.6 reliability: high
4.7 interface and output details: RS 232
4.8 power requirements: for measuring: 12 V (300 mA max; 150 mA mean);
for heating: 48 V (500 W max; 30 W mean)
4.9 servicing interval: 2 years minimum
4.10 other characteristics:
- The instrument is designed to measure and survive in all conditions of an Alpine climate.
- No moving parts (and other provisions) assure a maintenance free long live.
- The square-root characteristics of the hotwire gives a large dynamic range between 0.2 and 100 m/s
- Averaging the orthogonal components over many samples within one second and calculating wind speed and direction leads to representative results.

Experiences and other information

5. Experience from comparisons and tests performed: Good agreement with existing instruments in conditions without icing.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 20 / year energy consumption

7. Name and address of person responsible for further information:

Joss, Jürg
Osservatorio Ticinese dell'ISM
Via ai Monti 146
CH6605 Locarno Monti
Telefax: 093 31 78 78

8. Major bibliographic references, applicable patents, etc.:

- Joss and Gutermann: 'Orthogonales Wärmeübergangs Anemometer OWA', SMA Abt E 201.
- Jürg Joss: 'The challenge of designing and operating ground based observational instruments in Alpine terrain', Met. Rdsch 44, 1331 (Oktober, 1991)

Other entries related to this category:

1.21.3
1.21.4

1.7. Measurement of precipitation

Identification number: **1.7.1.** [3]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function: POSS (Precipitation Occurrence Sensor System) - measures precipitation type and intensity
2. State of development: Being commercialized. Procurement contract in place with Andrew Antenna Canada Ltd. Additional signal processing and software being developed to report accumulated precipitation and more complete present weather reports. Acceptance of manufactured units
   first year of operational use: 1992
3. Principle of operation: Precipitation fall velocity spectrum obtained using a bistatic 10.535 GHz Doppler radar. This spectrum is analyzed to determine presence, type and intensity of precipitation.
4. **Main technical characteristics:**

4.1 application: Automation of present weather observations.
4.2 measuring range: Very light to very heavy precipitation.
4.3 uncertainty:
4.4 time constant: 1 minute
4.5 averaging time: 1 minute
4.6 reliability:
4.7 interface and output details: Digital output from a single board computer. Designed to operate with an automatic weather station.
4.8 power requirements: 110 V AC
4.9 servicing interval: Approximately 1 year
4.10 other characteristics: Designed to operate in the diverse Canadian Climate with our READAC (Remote Environmental Data Acquisition Concept) Autostation.

Experiences and other information

5. Experience from comparisons and tests performed: Details have been provided at various meteorological conferences.
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:
   Wiggins, Larry
   4905 Dufferin Street
   Downsview, Ontario M3H 5T4,
   Canada
   Telefax: #416-668-8590
8. Major bibliographic references, applicable patents, etc.:
   Being manufactured by Andrew Canada Inc., fax #416-668-8590

Identification number: **1.7.2.** [8]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Rosemount 872 icing sensor
2. State of development: Cooperative venture with private industry (Rosemount

Inc.).
To be done: Minor software changes to be made prior to resumption of field testing.

first year of operational use: 1992

3. Principle of operation: Vibrating cylinder, frequency shift used to detect presence and amount of icing.

4. **Main technical characteristics:**

4.1 application: Automatic present weather observations
4.2 measuring range: —50°C - +50°C
4.3 uncertainty:
4.4 time constant: Instantaneous
4.5 averaging time: Instantaneous
4.6 reliability:
4.7 interface and output details: RS 232
4.8 power requirements: 110 V AC (1 A)
4.9 servicing interval:
4.10 other characteristics: Sensor interfaces to an automatic weather observing station or data logger. Special algorithms developed to report start times and end times of freezing precipitation events. Interfaces to our READAC (Remote Environmental Automatic Data Acquisition Concept) autostation.

Experiences and other information

5. Experience from comparisons and tests performed: Under test at various Canadian locations. Used operationally at one site.

6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: Unavailable

7. Name and address of person responsible for further information:
Wilson, Bob
4905 Dufferin Street
Downsview, Ontario M3H 5T4,
Canada

Telefax: #612-892-4430

8. Major bibliographic references, applicable patents, etc.:
Proprietary product, Rosemount Inc. Fax #612-892-4430

Identification number: 1.7.3. [47]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: Fog sampler for collection of fog or cloud droplets and subsequent chemical analysis.

2. State of development: Field test performed, calibration performed

3. Principle of operation: Impactor principle, sampling rate 140 m^3/h. Manual operation. Deposition plates removable for cleaning.

4. **Main technical characteristics:**

4.1 application: Fog water sampling above freezing point
4.2 measuring range: Fog particles above 5 µm diameter
4.3 uncertainty:
4.4 time constant:
4.5 averaging time: about 1 h
4.6 reliability:
4.7 interface and output details:

4.8 power requirements: 220 V
4.9 servicing interval: after use
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:
Winkler, Peter
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:
P. Winkler: "Design and calibration of a fog water collector", in: Instruments and Observing Methods Report No. 49: "Papers presented at the WMO Technical conference on Instruments and Methods of Observations, Vienna, 11 - 15 May 1992", WMO/TD-No. 462, pp 17 - 21.

Identification number: 1.7.4. [48]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: Semi-automatic fog sampler for collection of fog or cloud droplets, both above and below freezing point, and subsequent chemical analysis.

2. State of development: Prototype completed

3. Principle of operation: Impactor type, sampling rate 140 m^3/h. Self-adjusting isokinetic inlet according to wind velocity. Melting of frozen deposits during operation. Deposition plate removable for cleaning.

4. **Main technical characteristics:**
4.1 application: Fog water sampling above and below freezing point.
4.2 measuring range: Fog particles above 5 µm diameter
4.3 uncertainty:
4.4 time constant:
4.5 averaging time: about 1 h
4.6 reliability:
4.7 interface and output details:
4.8 power requirements: 220 V
4.9 servicing interval: after use
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:
Winkler, Peter
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg

Frahmredder 95
D-2000 Hamburg 65
Germany

Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.7.5.** [88]

Country: **Japan**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Tipping bucket raingauge with electro-magnetic valve

2. State of development: Now under field test
first year of operational use: Not yet decided

3. Principle of operation: During tipping of the bucket, water feeding to the bucket is suspended with a electro-magnetic valve to measure water volume without any missing even in case of heavy precipitation.

4. **Main technical characteristics:**

4.1 application: Precipitation measurements

4.2 measuring range: 0.5 mm

4.3 uncertainty: Less than ±0.5% at precipitation intensity < 20 mm/h; less than ±3% at precipitation intensity 20 - 150 mm/h

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: A relay contact (<0.1 second)

4.8 power requirements: 100 V AC, 50/60 Hz; 30 VA

4.9 servicing interval:

4.10 other characteristics: The gauge can be equipped with electric heater for cold ambience (—30 - 0°C)

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Nagasaka, Koichi
Senior assistant for International Affairs
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku
Tokyo 100,
Japan

Telefax: +81 3 3211 2032

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.7.6.** [117]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function: Sensor

of the amount and intensity of liquid, mixed and solid precipitation

2. State of development: Undergoing government acceptance testing

3. Principle of operation: Weight-to-frequency conversion

4. **Main technical characteristics:**

4.1 application: Liquid, mixed and solid precipitation measurements: Autonomous instrument for use in manned meteorological stations

4.2 measuring range: Precipitation measurement range: 0 - 150 mm

4.3 uncertainty: ±(0.2 + 0.02 Q) mm, where Q = amount of collected precipitation in mm

4.4 time constant:

4.5 averaging time: 10-min intervals for determining intensity

4.6 reliability: Not less than 10,000 h MTBF

4.7 interface and output details:

4.8 power requirements: 220 V,50 Hz

4.9 servicing interval:

4.10 other characteristics: Incorporated microprocessor, memorization of intensities (over 10-min intervals) for 24 hours, data output on the display panel and sequential channel, remote functioning up to 500 m

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Solomon, Persin
Karbysheva Str. 7
194018 Saint Petersburg
Russian Federation
Telefax: +7-812-2478661

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.7.7.** [140]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Use of a heated tipping bucket raingauge and precipitation detector to identify precipitation type and rate.

2. State of development: Field trials

3. Principle of operation: Monitor energy supplied to h.t.b.r. to differentiate between solid and liquid precipitation.

4. **Main technical characteristics:**

4.1 application: Use at automatic weather station

4.2 measuring range: To be determined

4.3 uncertainty: To be determined

4.4 time constant: To be determined

4.5 averaging time: To be determined

4.6 reliability: Good, as very simple system

4.7 interface and output details:

4.8 power requirements:

4.9 servicing interval:

4.10 other characteristics: A low cost alternative to optical present weather sensors using simple modifications to a standard tipping bucket raingauge.

Experiences and other information

5. Experience from comparisons and tests performed: Compares well with optical present weather detectors in initial field trials

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Hatton, David
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom

Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:

Stepek, A., Jones, D.W., Hatton, D.B. (1992): "Field Trials of Some Present Weather Sensors", WMO Instruments and Observing Methods Report No. 49, May 1992 (WMO/TD 462), pp. 284

Other entries related to this category:

1.3.1
1.21.3
1.21.4

1.8. Measurement of evaporation

Identification number: **1.8.1.** [103]

Country: **Poland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Ultrasonic precipitation, evaporation and temperature measuring device HMPW-01, instantaneous values of water level and water temperature in a evaporation pan.
2. State of development: Prototype, laboratory tests finished
3. Principle of operation: Ultrasonic transducer immersed in a evaporation pan emits short ultrasonic impulses in the direction of the water surface. Surface reflected sound wave travelling time is measured. Sound speed in water is measured separately and a correction according to water temperature is added. PC-computation of true water level and registration of all amounts of precipitation and evaporation is performed.
4. **Main technical characteristics:**

4.1	application:	Research and services
4.2	measuring range:	120 - 1200 mm of water column; 0 - 45°C
4.3	uncertainty:	±0.1 mm; ±0.1°C
4.4	time constant:	immediately
4.5	averaging time:	10 ms
4.6	reliability:	good
4.7	interface and output details:	IBM-PC
4.8	power requirements:	100 W
4.9	servicing interval:	Not available
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: Not available
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Not available

7. Name and address of person responsible for further information:
   Różdżyński, Kazimierz
   Sędzickiego 13
   81-384 Gdynia
   Poland
   Telefax:
8. Major bibliographic references, applicable patents, etc.:
   Memo only

Other entries related to this category:
1.21.3
1.21.4

1.9. Measurement of radiation

Identification number: **1.9.1.** [6]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function:
BW100 - UVB Radiation sensor

2. State of development: Cooperate development with private industry (Vital Technologies Inc., Bolton, Ontario, Canada).
To be done:
- Operational performance of sensor to be verified
- Calibration procedures to be determined
- Intercomparison with other UV sensors

3. Principle of operation: UV-B radiation measured using special filters, a photodiode, and processing electronics.

4. **Main technical characteristics:**

4.1	application:	
4.2	measuring range:	0 to 10 - Atmospheric Environment Service UV index units
4.3	uncertainty:	
4.4	time constant:	Instantaneous
4.5	averaging time:	Instantaneous
4.6	reliability:	
4.7	interface and output details:	Analogue, RS232 or current loop. Output to a PC or data logger.
4.8	power requirements:	9 V DC
4.9	servicing interval:	To be determined
4.10	other characteristics:	Designed to operate with a personal computer or data logger.

Experiences and other information

5. Experience from comparisons and tests performed: Field testing underway

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Unavailable

7. Name and address of person responsible for further information:
Cook, John
4905 Dufferin Street
Downsview, Ontario M3H 5T4,
Canada
Telefax: 416-739-5721

8. Major bibliographic references, applicable patents, etc.:
Proprietary product of Vital Technologies Ltd., Bolton, Ontario, Canada. Telefax: 951-0097

Identification number: **1.9.2.** [15]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: The radiation from sun and half-globose sky will be measured by the type DFY4-1 Pyrradiometer when they shine on the acceptant-flat surface of Pyrradiometer.

2. State of development: The errors for the altitude angles of the sun 10° and 170° were under ±15% now, some of them were under 5%.
first year of operational use: Since the instrument is put into use, all of them worked well except one or two quartz hoods of the Pyrradiometer were broken.

3. Principle of operation: The operating principle of the instrument is based on the thermoelectrical effect, when the black-body have absorbed radiant energy the thermoelectricity will be turned - up and its output voltage is a direct proportion with intensity of radiation. While matching to micro-computer, it can measure remotely and automatically.

4. **Main technical characteristics:**

4.1 application: temperature: ±45°C, humidity: < 95%

4.2 measuring range: wavelength: 0.3 - 4 μm

4.3 uncertainty:

altitude angle	10°	20°	40°	70°
error	≤ 0.15	≤ 0.11	≤ 0.08	≤ 0.03

4.4 time constant: ≤ 15 sec (95%)

4.5 averaging time: N/A

4.6 reliability: no - wrong time 10,000 h

4.7 interface and output details: The interface output the signal of sampling

4.8 power requirements: 7w

4.9 servicing interval: 2 years

4.10 other characteristics:

Sensitivity: 7 - 14 $\mu V/W \cdot m^{-2}$

Internal resistance: ≤ 80Ω

Sensor level: Black

Optical window: Two-layer half-globe quartz hood

Thermopile: Constantan-Copper coil

Aperture angle: 360°

The constant of sensitivity for one year (%): ±2

Other functions: -Measuring the radiation with ground reflect
-Measuring the radiation with atmosphere scatter

Experiences and other information

5. Experience from comparisons and tests performed: Application and contrast result proved that precision of type DFY4-1 Pyrradiometer is better than the type DFY2 Pyrradiometer.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

ZengYi, Xiu
10 Nanling Street,
Chung Chun 130022
China
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.9.3.** [16]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: The type DFY3 pyrheliometer with auto-tracker is a analog system that imitates the solar movement. Thereby the direct solar radiation and rather narrow ring atmospheric radiation on around the sun can be measured all the time

2. State of development: Because we improved the constitution, the precision of auto-tracker is risen.
   first year of operational use: The DFY3 Pyrheliometer in operational use in Jan, 1992 worked well except the one or two tracker had some wrong.

3. Principle of operation: The operating principle of this instrument is based on the thermo-electrical effect. the tracker drive pyrheliometer to adjust the sun all the time, continue measure the direct solar radiation from the sun. While matching to micro-computer, it can measure remotely and automatically.

4. **Main technical characteristics:**

4.1	application:	Temperature: ± 45°C, Humidity: < 95%
4.2	measuring range:	Wavelength: 0.3 - 4 μm
4.3	uncertainty:	Tracking accuracy: ≤ ± 1 (24h)
4.4	time constant:	≤ 6 sec (95%)
4.5	averaging time:	N/A
4.6	reliability:	no - wrong time 4,000 h
4.7	interface and output details:	The interface output the signal of sampling
4.8	power requirements:	N/A
4.9	servicing interval:	One year
4.10	other characteristics:	

Sensitivity: 7 - 13 $\mu V/W \cdot m^{-2}$
The constant of sensitivity for one year (%): ±1
Internal resistance: ≤ 80Ω
Sensor level: Black
Optical window: Quartz plate
Thermopile: Constantan-Copper coil
Aperture halfangle: 3°12′19"
Other functions: Tracking sun automatic, when the direct solar radiation s ≥ 120 Wm^{-2}, it can record the sunshine automatically.

Experiences and other information

5. Experience from comparisons and tests performed: The auto-tracker sometimes generate fault during application, when we adjust light-spot, we must loosed the long nut which making the pyrheliometer and auto-tracker into ensemble, or else the gear suit will be damaged.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

ZengYi, Xiu
10 Nanling Street,
Chung Chun 130022
China

Telefax:

8. Major bibliographic references, applicable patents, etc.:

Identification number: **1.9.4.** [17]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: The type DFY5 net radiometer receives the difference of the radiation from the sun. The earth and atmosphere above and under a regular level.

2. State of development: The error of the instrument between the wavelengths of longwaves and shortwave was under 15%, most of them was under 10%.
   first year of operational use: The first type DFY5 net radiometer in operational use from the beginning of 1990 worked well and had no problem.

3. Principle of operation: The operating principle of this instrument is based on the thermo-electrical effect. Two black bodies were conglutinated both on the top level and bottom level of the thermopile closely, to measure the difference of the total radiation strength, while matching to micro-computer, it can measure remotely and automatically.

4. **Main technical characteristics:**

4.1	application:	Temperature: ±15°C , humidity: < 95%
4.2	measuring range:	Wavelength: 0.3 - 30 μm
4.3	uncertainty:	Sensitive error between longwave and short-wave ≤ 10%
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	No-wrong time 7,000 h
4.7	interface and output details:	The interface output the signal of sampling
4.8	power requirements:	7w
4.9	servicing interval:	2 years
4.10	other characteristics:	
	Sensitivity:	7 - 14 $\mu V/W \cdot m^{-2}$
	Time constant:	< 30 sec (95%)
	Internal resistance:	< 80Ω
	Look-out angle:	4°
	Thermopile:	Constantan-Copper coil
	Optical window:	half-globe PVC film hood
	Sensor level:	Top and bottom black levels

The constant of sensitivity for one year (%): ±5

Experiences and other information

5. Experience from comparisons and tests performed: Because the quality of radiant lacquer rose, the error between the longwave and shortwave have been depressed for the instrument which was put into use in 1992.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

ZengYi, Xiu
10 Nanling Street,
Chung Chun 130022
China

Telefax:

8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **1.9.5.** [29]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Azimuth follower mount (azimuth instrument to follow the sun automatically)
2. State of development: Phase of qualification in the field
3. Principle of operation: Azimuth mount (to be orientated in azimuth and in zenith distance) controlled by a micro-processor. It points towards the sun based on the equation of time. the aim is refined by an optical follower submitted by the centre of the sun.
4. **Main technical characteristics:**

4.1	application:	The pyrheliometer is controlled according to the new W.M.O. recommendations
4.2	measuring range:	± 180° in azimuth, 0 - 90° in zenith
4.3	uncertainty:	Equation of time: 0.3°, control of the optics: 0.1°
4.4	time constant:	
4.5	averaging time:	360° within 14 seconds
4.6	reliability:	Leakage resistant and sealed against sandy wind.
4.7	interface and output details:	Serial interface for initiation
4.8	power requirements:	Autonomous
4.9	servicing interval:	1 year to 5 years (by turns)
4.10	other characteristics:	Equatorial precision mounts are very expensive and exacting to install. Azimuth mounts are less expensive and very easy to install (but the calculation of the position of the sun requires the use of micro computers). Since these mounts need only a good levelling as the first solar rays (at set up) allow calculation of all necessary corrections. After set up, the system will correct by itself the derivation of its time of reference.

Experiences and other information

5. Experience from comparisons and tests performed: Verification with photometric applications of the precision of the sun ray direction indicator.
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	US$ 400 / year

7. Name and address of person responsible for further information:
   CIMEL ELECTRONIQUE
   5, Cité de Phalsbourg
   75011 Paris,
   France
   Telefax: (33) 1 43.48.62.61
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **1.9.6.** [50]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: UHU-SOLAR. Measuring system for diffuse and direct solar radiation, global radiation, sunshine duration, and turbidity.

2. State of development: Experimental pre-prototype

3. Principle of operation: Small sensor head with rotating slit-diaphragm and pyranometer-like receiver characteristic. Computer-controlled motion, data acquisition and processing. Separation of direct and diffuse components by software (peak detection). Application of correction functions. Calculation and visualisation of results.

4. **Main technical characteristics:**

4.1 application: Measurement of main components of solar radiation with one single sensor.

4.2 measuring range: Usual range for radiation quantities

4.3 uncertainty: Comparable to WMO class II pyranometer

4.4 time constant: 1 measurement every 2..3 seconds

4.5 averaging time: defined by user

4.6 reliability:

4.7 interface and output details: System consists of sensor head, control interface, computer, and optional output devices (printer, disk drivers)

4.8 power requirements: 220 - 240 V AC, consumption depending on computer type

4.9 servicing interval: Not yet specified

4.10 other characteristics: Limitations exist concerning geographical latitude, as measurements at solar positions close to the zenith or to the horizon cannot be made with reasonable accuracy.

Data scanning rate: 1 set of values every 2..3 seconds

Size: sensor head L×W×H = 120×120×200 mm

Weight: 2.5 kg

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Energy costs for approx. 100 - 150 VA continuous power. Expendables approx. US$ 30 - 50.

7. Name and address of person responsible for further information:

Bergholter, Uwe
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany

Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:

Bergholter, U. and Dehne, K.: "Messung von direkter und diffuser Sonnenstrahlung mittels SONIe-Sonnenscheinsensor", Abschlußbericht zum Forschungsvorhaben MOH/14. DWD, MetObs Hamburg (August 1992)

Identification number: **1.9.7.** [51]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Solar tracker, carrier for instruments which have to follow the sun's path, e.g. sunphotometers, pyrheliometers and experimental devices

2. State of development: Prototype will start operation in 1993. software and wiring have to be completed.

3. Principle of operation: Two-axis amateur-antenna-rotor with computer-control for coarse suntracking, quadrant detector feedback for automatic fine adjustment.

4. **Main technical characteristics:**

4.1	application:	Suntracking for radiation sensors
4.2	measuring range:	u.a.
4.3	uncertainty:	planned: better than 0.1 degree
4.4	time constant:	u.a.
4.5	averaging time:	u.a.
4.6	reliability:	not yet known
4.7	interface and output details:	Interfacing to standard PC/XT/AT by A/D-D/A plug-in-board
4.8	power requirements:	200 - 240 V AC
4.9	servicing interval:	half a year or more
4.10	other characteristics:	The rotor is capable of carrying loads up to 200 kg. Maximum rotational torque is 14 kgm (elevation) or 7 kgm (azimuth) for unbalanced loads.

Experiences and other information

5. Experience from comparisons and tests performed: none

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Energy costs for approx. 150 VA continuous power

7. Name and address of person responsible for further information:

Bergholter, Uwe
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95,
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:

Identification number: 1.9.8. [60]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function:
Photoelectric detector for the measurement of the photolysis frequency $J_{O'D}$

2. State of development: Small series under construction

3. Principle of operation: Sampling of light by an inlet system with 2π uniform response. Two coupled units with 4π response. Selection of wavelength interval of interest by interference filters. Light detection by photomultiplier or photodiode.

4. **Main technical characteristics:**

4.1	application:	air chemistry investigations
4.2	measuring range:	0 - $5\times10_{-5}$ /sec
4.3	uncertainty:	±15 %
4.4	time constant:	1 sec
4.5	averaging time:	1 sec
4.6	reliability:	Continuous operation possible
4.7	interface and output details:	Output 0 - 5 V, digital output on request
4.8	power requirements:	18 - 30 V DC, 50 mA

4.9 servicing interval: six months

4.10 other characteristics: Weatherproof system, cleaning of inlet optics required regularly, operation temperature range —20 - +35°C

Experiences and other information

5. Experience from comparisons and tests performed: Calibration against a chemical actinometer

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Approx. US$ 3,000 (Calibration)

7. Name and address of person responsible for further information:

Junkermann, Wolfgang
Fraunhofer-Institut für atmosphärische Umweltforschung
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany

Telefax: 49-8821-73573

8. Major bibliographic references, applicable patents, etc.:

- Junkermann, W.: " Einlassystem für Photodetektoren mit 180 Grad Bildwinkel und damit versehene Detektoren", Patent P 36 42 275.4, 1987
- Junkermann, W. Platt, U., Volz, A.: "A Photoelectric Detector of the Measurement of Photolysis Frequencies of Ozone and other Atmospheric Molecules", Journal of Atmospheric Chemistry, 8 (1989) 203-227
- Junkermann, W.: United States Patent No. 4814605, March 21, "Entrance System for a Photoelectric Detector having a 180 Degree Image Angle and Detector Provided Therewith", 1989

Identification number: 1.9.9. [65]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: System of seven 2π-radiometers for total solar radiation from different regions of the solid angle. results: Direct solar radiation, global radiation, reflected radiation, vector of solar net flux density, and radiation supply (called "solar acrinic flux" in photochemistry).

2. State of development: Calibration including detailed catacaustic effects completed. Field tests in near future.
first year of operational use: 1993 or 1994

3. Principle of operation: Standard technology since only commercially available instruments are used.

4. **Main technical characteristics:**

4.1 application: Ground based measurements

4.2 measuring range: Standard

4.3 uncertainty: 2 - 10 percent depending on the derived property

4.4 time constant: About 30 sec

4.5 averaging time: 10 min

4.6 reliability: Standard

4.7 interface and output details: Automatic data acquisition with battery operated system using Hewlett Packard IL - components.

4.8 power requirements: No.

4.9 servicing interval: Not explicitly known

4.10 other characteristics: No definite answers are possible at present

Experiences and other information

5. Experience from comparisons and tests performed: Cannot be answered at present

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 500 - 1000

7. Name and address of person responsible for further information:

Hänel, Prof. dr. Gottfried,
Institute of Meteorology and Geophysics
Feldbergstraße 47
D-6000 Frankfurt/Main
Fed. Rep. of Germany

Telefax: +49-69-7983280

8. Major bibliographic references, applicable patents, etc.:

- Hänel, G. (1989), unpublished manuscript describing the theory of data evaluation. Publication of this theory and on first results of measurements in 1994.

Identification number: 1.9.10. [119]

Country: Switzerland

General information

1. Short identification of the instrument including the parameter measured, or its function: Rasta, Automatic system to measure the direct solar radiation, as a function of the spectrum (or not).

2. State of development: On site tests

3. Principle of operation: Automatic system to measure the direct solar radiation, including:
   1. Automatic passive sun follower
   2. 1 absolute radiometer, PM06
   3. 1 treble photometer (wavelengths: 368, 500, 778 nm), SP 20001

4. **Main technical characteristics:**

4.1 application: Continuous measurement of the direct solar radiation

4.2 measuring range: PM06: 0..1500 W/m^2, SPM2000: 0..5 Volts

4.3 uncertainty: PM06: ± 0.2%, SPM2000: ± 2%

4.4 time constant:

4.5 averaging time: PM06: 10 minutes, SPM2000: instantaneously

4.6 reliability: Automatic measurements without intervention

4.7 interface and output details: RS 232

4.8 power requirements: 24 Volts (10 Amp.)

4.9 servicing interval: 6 months, 1 year for calibrations

4.10 other characteristics:

1) Objects in view:
- Determination of a climatology of direct radiation for Switzerland
- Monitoring of the development of atmospheric turbidity, *e.g.* in the case with passages of stratospheric clouds of volcanic origin (El Chichon, Pinatubo)

2) Completely automatic measuring system developed to work under any meteorological condition.

Experiences and other information

5. Experience from comparisons and tests performed:
   - Very good results on the pilot station
   - Problems with respect to the motors for the sun follower
   - Degradation of the filter (part. in UV) of the photometer.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: undetermined

7. Name and address of person responsible for further information:

Heimo, Alain
Institut suisse de météorologie
Station Aérologique
Section Instruments
CH1530 Payerne
Switzerland
Telefax: 037 61 11 94

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
1.6.4

1.10. Measurement of visibility

Identification number: **1.10.1.** [73]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Slant Visual Range (SVR)
2. State of development: Prototype on trial with Ministry of Traffic (BMW) under supervision of the German Weather Service (DWD)
3. Principle of operation: LIDAR with GaAs Laser-diode
4. **Main technical characteristics:**

4.1	application:	SVR
4.2	measuring range:	50 - 2000 m
4.3	uncertainty:	Less than 5%
4.4	time constant:	15 sec
4.5	averaging time:	15 sec
4.6	reliability:	Better than 95%
4.7	interface and output details:	FSK
4.8	power requirements:	600 W, incl. heating
4.9	servicing interval:	No specific service intervals
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: Good results compared to RVR at DWD trials in Quickborn, Germany, as well as good results at trials on Hamburg Airport.
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Costs for power supply only

7. Name and address of person responsible for further information:

Münkel, Christoph
Impulsphysik Hagenuk GmbH
P.O. Box 1349
D-2000 Schenefeld/Hamburg
Germany
Telefax: 040-83900610

8. Major bibliographic references, applicable patents, etc.:

- Measrures, R.M. (1984): "Laser remote sensing", Wiley-Interscience Publication
- Klett, J.D. (1981): "Stable analytic inversion solution for processing lidar returns", Appl. Opt. 20 (1981) 211
- Koschmieder, H. (1924): "Theorie der horizontalen Sichtweite", Habilitationsschrift Frankfurt a.M.
- Streicher, J., Werner, Ch., Berghaus, U., Gatz, H., Gelbke, E., Lisius, A., Münkel, C. (1988): "Prototyp eines Meßgeräts zur Erfassung der Schrägsichtweite" ("Prototype of a Slant Visual Range Measuring Device"), DFVLR FB 88-42 (Internal publication available from DFVLR, Oberpfaffenhofen, D-8031 Weßling/Obb., Germany)
- Werner, Ch. (1981): "Determination of the slant range visibility from lidar signatures using the two-point-method", Optics and Laser Technology Vol. 7, pp.27-36
- Streicher, J., Münkel, C., Borchardt, H.: "Trial of a Slant Visual Range Measuring Device", J. Atmosph. Ocean. Techn.
- Patent: DE 33 16 600 C2

Other entries related to this category:

1.3.1
1.21.4

1.11. Cloud observation

Identification number: **1.11.1.** [30]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Nephelometer - Measurements of the apparent radiation temperature of the cloud base. Analysis of the thermic profile.
2. State of development: Feasibility Studie, Demonstrator, Evaluation of the precision; Availability 2nd quarter 1994
3. Principle of operation: Thermic Infrared multiwave Radiometer mounted on a turret and controlled by a micro processor. By scanning, the temperatures of the sky are analyzed.
4. **Main technical characteristics:**

4.1	application:	Characteristics of the cloud coverage
4.2	measuring range:	—80°C - +50°C and qualification of the cloud amount.
4.3	uncertainty:	0.3°C (at —30°C)
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	Digital output
4.8	power requirements:	Possibly autonomous (solar energy)
4.9	servicing interval:	
4.10	other characteristics:	As basic operation principle, the instrument scans the sky with a constant zenith distance of 20°. It measures the temperature within a range of 3° and by interpretation it will give: The number of octants of the coverage and the classification of the cloud amount (lower , middle, upper). Moreover, for isolated clouds, repeatedly developed vertically, it determines a temperature profile.

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	US$ 400

7. Name and address of person responsible for further information:
   CIMEL ELECTRONIQUE
   5, Cité de Phalsbourg
   75011 Paris,
   France
   Telefax: (33) 1 43.48.62.61
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **1.11.2.** [139]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Cloud layer amounts and heights using a laser cloud base recorder

2. State of development: Field trials

3. Principle of operation: Use of exponential decay algorithms to identify cloud layers and amounts

4. **Main technical characteristics:**

4.1	application:	Automatic Weather Stations
4.2	measuring range:	50 ft to 24,000 ft
4.3	uncertainty:	To be determined
4.4	time constant:	Hourly report
4.5	averaging time:	Exponential
4.6	reliability:	As good as cloud base recorder
4.7	interface and output details:	Computer interface
4.8	power requirements:	N/A
4.9	servicing interval:	Not required
4.10	other characteristics:	Results will differ from human observations and field trials taking place to quantify any differences.

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Hatton, David
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom

Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.11.3.** [141]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Cloud cover measurements from colour camera images

2. State of development: Feasibility trials

3. Principle of operation: Machine analysis of pixels of a colour video camera image of the sky.

4. **Main technical characteristics:**

4.1	application:	Automatic cloud analysis
4.2	measuring range:	N/A
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	N/A
4.7	interface and output details:	N/A
4.8	power requirements:	Not available
4.9	servicing interval:	Not available
4.10	other characteristics:	Segmentation in two dimensional colour space and development of computer vision techniques

Experiences and other information

5. Experience from comparisons and tests performed: Not available

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:

Jones, D.W.
Meteorological Office, Met O(OI)1,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom

Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:

Richards, K., Sullivan, G.D., Jones, D.W. (1992): "Colour segmentation of cloud image data", WMO Instruments and Observing Methods Report No. 49, May 1992 (WMO/TD 462), pp. 295

Other entries related to this category:

1.3.1
1.21.4

1.12., 1.13., 1.14.: N/A

1.15. Observation of atmospherics

-None-

1.16. Instruments and observations at aeronautical meteorological stations

Identification number: **1.16.1.** [144]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind averager: Displays 2 minute mean wind speed and direction, maximum gust in last 10 minutes plus variability of speed and direction over last 10 mins.
2. State of development: Pre-production model nearing completion
3. Principle of operation: Wind input is digitized, averaging and extreme capture is controlled by microprocessor. Continuous digital display of wind averages, gusts and variability is provided
4. **Main technical characteristics:**

4.1	application:	Wind display for aircraft controllers
4.2	measuring range:	Direction: 0 - 360 deg, speed: 0 to 99 kn
4.3	uncertainty:	Direction: ±1 deg, speed: ±1%
4.4	time constant:	Determined by wind system
4.5	averaging time:	Wind: 2, 10 minutes, variability 10 minutes
4.6	reliability:	Estimated MTBF > 10,000 hrs
4.7	interface and output details:	Accepts all current wind systems (land) in use at UK Met Offices. Serial output available.
4.8	power requirements:	230 V AC at 50 Hz
4.9	servicing interval:	To be determined
4.10	other characteristics:	Utilizes standardised wind algorithms

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Not available

7. Name and address of person responsible for further information:

Wright, Alan
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom
Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
1.3.4, 1.3.5
1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9
1.6.1
1.7.6
1.22.2, 1.22.5

1.17. Marine observations:

-None-

Other entries related to this category:
1.5.5, 1.5.6, 1.5.7, 1.5.8

1.18., 1.19., 1.20.: N/A

1.21. Measurement of sunshine duration

Identification number: **1.21.1.** [4]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Micropower sunshine sensor - measures sunshine duration
2. State of development: Being field tested in Canada and U.S.A. (Confirmation of operational suitability).
3. Principle of operation: Sky contrast equating to bright sunshine is measured using a special photodiode arrangement
4. **Main technical characteristics:**

4.1	application:	Automatic Weather Observing, Replaces Campbell Stokes Sunshine Recorder
4.2	measuring range:	+50°C to —50°C. Threshold presently set at 125 W/m^2
4.3	uncertainty:	
4.4	time constant:	N/A
4.5	averaging time:	2 sec.
4.6	reliability:	
4.7	interface and output details:	Digital (Inverse current loop ASCII) and Event (Contact closure).
4.8	power requirements:	12 V DC
4.9	servicing interval:	1 year
4.10	other characteristics:	

   - Not affected by snow on ground
   - Suitable for sun angles of 0 - 75°
   - Designed to operate with an automatic weather station, data logger or other recording device.

Experiences and other information

5. Experience from comparisons and tests performed: Under test in Canada and U.S.A. long term averages compare favourably with sun tracking radiometers. Presently custom made, however, a commercial supplier is being sought.
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Negligible

7. Name and address of person responsible for further information:
   Cook, John
   4905 Dufferin Street
   Downsview, Ontario M3H 5T4,
   Canada
   Telefax: 416-739-5721

8. Major bibliographic references, applicable patents, etc.:
Details on the sensor and its performance have been presented at various meteorological conferences.

Identification number: **1.21.2.** [109]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Sunshine sensor D4 for determining the presence of direct solar radiation

2. State of development:

3. Principle of operation: Conversion of the intensity of direct solar radiation into an electrical signal and detection of the exceeding of a threshold

4. **Main technical characteristics:**

4.1	application:	Determination of the presence of direct solar radiation
4.2	measuring range:	Energy intensity 120 W/m^2 (threshold)
4.3	uncertainty:	(error) 10%
4.4	time constant:	< 1 sec
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	State of transistor-type electronic switch with an open collector
4.8	power requirements:	DC source: 10 - 16 V, power < 50 mW
4.9	servicing interval:	1 year
4.10	other characteristics:	Does not require orientation according to sun's evaluation during on-site installation

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.21.3.** [133]

Country: **Thailand**

General information

1. Short identification of the instrument including the parameter measured, or its function:

2. State of development:

3. Principle of operation: Electrical and mechanical technology

4. **Main technical characteristics:**

4.1	application:	Operational forecast for agriculture, agricultural research and statistics

4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability: Reliable
4.7 interface and output details: Analog output
4.8 power requirements: 220 V AC, 50 Hz
4.9 servicing interval: Every year
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: US$ 80,000 (BAHT 2 million)

7. Name and address of person responsible for further information:
Suppjaroen, Nugool
Meteorology Instrument Div.
4353 Sukumvit road
Bangkok
Thailand
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 1.21.4. [134]

Country: Thailand

General information

1. Short identification of the instrument including the parameter measured, or its function:

2. State of development:

3. Principle of operation: Electrical and mechanical technology

4. **Main technical characteristics:**
4.1 application: Operational forecast for agriculture, agricultural research and statistics
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability: Reliable
4.7 interface and output details: Analog output
4.8 power requirements: 220 V AC, 50 Hz
4.9 servicing interval: Every year (control: Every 3 hours)
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: US$ 80,000 (BAHT 2 million)

7. Name and address of person responsible for further information:
Suppjaroen, Nugool
Meteorology Instrument Div.
4353 Sukumvit road

Bangkok
Thailand

Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
1.9.6

1.22. Automatic meteorological stations

Identification number: **1.22.1.** [1]

Country: **Brazil**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Electronic data-acquisition module originally designed for storing water level and precipitation measurements at programmable time intervals, functioning exclusively in stand-alone mode.

2. State of development: 90% completed, including projects for firmware, hardware and artistic lay-out of printed circuit.

3. Principle of operation: Digital electronic solid-state recorder without moving parts, capable of storing a volume of information over along period under autonomous regime, capable of handling processing of data from hydrometeorological networks operating in difficult conditions, mainly in remote areas. Has electronic features with low power consumption based on microprocessor which has a quartz crystal time unit operating with a high level of stability and precision.

4. **Main technical characteristics:**

4.1	application:	Measurement of hydrometeorological parameters (essentially water level and precipitation)
4.2	measuring range:	Programmable, from one day to one year.
4.3	uncertainty:	
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	Data extraction by serial communication
4.8	power requirements:	+12 VDC (90 mA), —12 VDC (10 mA)
4.9	servicing interval:	

4.10 other characteristics:
- Data extraction: Via serial communication over UMF/VHF radio, cable, satellite, telephone line or data collector.
- By expansion, permits acquisition of other hydrometeorological parameters, such as wind speed and direction, relative humidity, barometric pressure and air temperature through RS 485 communication.
- Organization of data: 1440 × 8 bits.
- Autonomy: From one day to 12 months.
- Communication rate: 300, 600 or 1200 baud

Experiences and other information

5. Experience from comparisons and tests performed: N/A

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Jorge Matias da Silva
R. Piauí, 151
Todos os Santos,
Rio de Janeiro,
RJ - Brasil.

Telefax: 00-55-021-593-3346

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.22.2.** [2]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function: Readac (Remote Environmental Automatic Data Acquisition Concept) automatic weather station

2. State of development: Ongoing, updating modules/components due to changing technology and requirements. New data formats, archiving requirements, communications media to be determined
   first year of operational use: 1991

3. Principle of operation: Multiprocessor based, each sensor is functionally independent although individual sensor interfaces can obtain and use data from other sensors.

4. **Main technical characteristics:**

4.1	application:	Aeronautical, hourly and climatological observations
4.2	measuring range:	standard meteorological ranges
4.3	uncertainty:	meets aviation requirements for most parameters
4.4	time constant:	observations provided every minute
4.5	averaging time:	varies from 5 seconds to 1 hour
4.6	reliability:	
4.7	interface and output details:	Modem to telephone line. Output to voice synthesizer also available
4.8	power requirements:	110 V AC
4.9	servicing interval:	3 months to 1 year
4.10	other characteristics:	Designed to produce hourly and special observations plus climatological data. Capable of operating autonomously or in conjunction with human observer. Special attention paid to EMI and lightning protection. Rugged and will operate in harsh environments. Readily expandable.

Experiences and other information

5. Experience from comparisons and tests performed: Compares favourable to human observations. Internal reports available.

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	dependant on sensor complements.

7. Name and address of person responsible for further information:

Robinson, Earle
4905 Dufferin Street
Downsview, Ontario M3H 5T4
Canada

Telefax: 416-739-5721

8. Major bibliographic references, applicable patents, etc.:
   - "Readac" has been trademarked to the Atmospheric Environment Service.
   - Papers on READAC and its performance have been presented at a number of meteorological and aviation conferences
   - Licensed to Valcom Ltd., Guelph, Ontario, Canada; telefax: #519-824-3411

Identification number: **1.22.3.** [41]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic observation station and for observational support: Sensors + Automatic Station + Observation computer (CAOBS, calculateur d'observation)

2. State of development: Development will be finished in 1993
first year of operational use: 1991

3. Principle of operation: By using the automatic stations (MIRIA), the numerical transmissions with the CIBUS sensors and a PC type micro computer in order to store, to manage (codes and messages) and to interface with a human observer.

4. **Main technical characteristics:**

4.1 application: Synoptical and/or Aeronautical

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: 12 V solar energy to 220 V (200 W), like CAOBS.

4.9 servicing interval: 1 year

4.10 other characteristics: There exist several versions of the system (existing or under development), applied in the following fields:
- aeronautics
- synoptic sites, civilized or isolated
- use of several transmission types: Special lines, Telecommunication network, Geostationary meteorological satellite.

Experiences and other information

5. Experience from comparisons and tests performed: reliable for the whole chain, thanks to digital interfaces.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Variable, depends on the configuration

7. Name and address of person responsible for further information:
Leroy, Michel
SETIM
7, rue Teisserence de Bort
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.22.4.** [71]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: ABWST (Automatische Bordwetterstation = Automatic Ship Weather Station) for measurement of atmospheric pressure, air temperature, water temperature, relative humidity, surface wind, position, speed and course of the vessel

2. State of development: prototype under test, first units operational in 1993

3. Principle of operation:
- 16 bit C-MOS microprocessor-controlled automatic system for data acquisition and processing
- multitasking operating system
- multilayer technique
- flash EPROM

4. **Main technical characteristics:**

4.1 application: Automatic data acquisition from sea

4.2 measuring range: N/A

4.3 uncertainty: N/A

4.4 time constant: N/A

4.5 averaging time: N/A

4.6 reliability: N/A

4.7 interface and output details: Input interfaces: Analog, digital parallel, digital serial, frequency; output interfaces: Digital serial

4.8 power requirements: 220 V, 50 Hz, max. 150 VA

4.9 servicing interval: twice per year (planned)

4.10 other characteristics:
- autonomous system
- easy to install (very compact - only 1 main unit)
- outdoor mounting under shipboard conditions
- generation of meteorological reports via DCP / satellite
- raw signal / data conversion including linearization
- quality control: Range checks, variability checks
- optional PC for onboard data presentation, manual inputs and storage of messages on floppy disk

Experiences and other information

5. Experience from comparisons and tests performed: Predecessor type has been successfully tested against human measurements

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 5,000 (estimated)

7. Name and address of person responsible for further information:

Däke, Dr. Claus Uwe
Deutscher Wetterdienst
Instrumentenamt Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany

Telefax: +49-40-60173102

8. Major bibliographic references, applicable patents, etc.:
Günther, H.: "Vergleigh der mit der ABWST gewonnen und der von den Nautikern durchgeführten Messungen auf der Stuttgart Express", Internal Report - not published, DWD-SWA 1992, in German

Identification number: **1.22.5.** [116]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Aerodrome meteorological measurement - information system

2. State of development: Preparation of prototypes; acceptance testing for the main sensors in 1993

3. Principle of operation: New-generation system based on "intelligent" autonomous sensors and PC

4. **Main technical characteristics:**

4.1 application: To equip categorized and uncategorized aerodromes.

4.2 measuring range: Corresponds to ICAO category IIIa

4.3 uncertainty:

4.4 time constant: Updating interval for resultant data: No worse than 15 sec

4.5 averaging time:

4.6 reliability: 1000 h MTBF

4.7 interface and output details: Unified digital data-collection interface; data output FM-12, METAR, etc.

4.8 power requirements:

4.9 servicing interval:

4.10 other characteristics:

- Measured parameters:
  · height of cloud base: 15 ... 2000 m
  · meteorological optical range: 20 ... 6000 m
  · background luminance: 10 ... 1200 cd/m^2
  · precipitation intensity, wind parameters, atmospheric pressure, temperature, air humidity
- Remote functioning: up to 18 km
- Autonomous digital instruments
- variations of system assembly for different aerodromes
- considerable possibilities for data processing, presentation, storage and output.

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Solomon, Persin
Karbysheva Str. 7
194018 Saint Petersburg
Russian Federation

Telefax: +7-812-2478661

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **1.22.6.** [138]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Climatological Data Logger

2. State of development: Field Trials

3. Principle of operation: A selection of meteorological sensors regularly logged, stored and available for remote interrogation

4. **Main technical characteristics:**

4.1	application:	Automatic sampling & storage of meteorological information
4.2	measuring range:	-
4.3	uncertainty:	-
4.4	time constant:	-
4.5	averaging time:	-
4.6	reliability:	Very good in field trials
4.7	interface and output details:	Modem/telephone or radio link
4.8	power requirements:	Not available
4.9	servicing interval:	Not available

4.10 other characteristics:
Some or all of the following parameters can be logged:
- Wind speed, wind direction, max. gust;
- Air temperature, wet bulb temperature, soil temperature, grass & concrete temperature;
- Relative humidity
- Precipitation

Experiences and other information

5. Experience from comparisons and tests performed: Not available

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Hatton, David
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom
Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
1.2.1
1.2.2
1.2.4
1.3.4
1.4.2
1.5.6
1.5.8

1.23. Soil moisture measurements

Identification number: **1.23.1.** [10]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: Type IAG-III Intelligent Neutron Moisture Meter. It is used for measuring the moisture content of soil.
2. State of development:
   first year of operational use: 1992
3. Principle of operation: The fast neutrons generated from neutrons source of the probe, are come into collision with the atoms of soil, especially Hydrogen atoms of water in soil, and cause the fast neutrons scattered, slowing-down and loosing their energy, thus from slow neutrons. The density of slow neutrons is a function of the soil moisture contents.
4. **Main technical characteristics:**
4.1 application:
4.2 measuring range: 0 - 100 %RH
4.3 uncertainty: 0.28% (under moisture content 24%)
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details: digital output
4.8 power requirements: 1.5 V DC or 1.2 V (1.8 Ah) Ni-Cd battery
4.9 servicing interval:
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:
7. Name and address of person responsible for further information:

Sun Jinyuan
Dept. of Technical Facilities
State Meteorological Administration
46, Baishiqiaolu,
Beijing 100081,
China
Telefax:

8. Major bibliographic references, applicable patents, etc.:

Other entries related to this category:
1.21.3

1.24. Measurement of atmospheric composition, toxic chemicals and radioactive substances

Identification number: **1.24.1.** [61]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Gas chromatograph coupled with mass spectrometer, measurement of freons and their substitutes
2. State of development: just started
3. Principle of operation:
4. **Main technical characteristics:**
4.1 application: Specifications not yet available
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details:
4.8 power requirements:
4.9 servicing interval:
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: No experience available yet
6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: Approx. US$ 20,000
7. Name and address of person responsible for further information:
Slemr, Dr. Franz
Fraunhofer-Institut für atmosphärische Umweltforschung
(Fraunhofer-Institute for Atmospheric Environment. Research)
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany
Telefax: 49-8821-73573
8. Major bibliographic references, applicable patents, etc.:
Not yet available

Identification number: **1.24.2.** [62]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automated gas chromatograph with cryoenrichment, cryofocussing for determination of C_2 - C_6 hydrocarbons
2. State of development: just started
3. Principle of operation:
4. **Main technical characteristics:**
4.1 application: Specifications not yet available
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:

4.5 averaging time:
4.6 reliability:
4.7 interface and output details:
4.8 power requirements:
4.9 servicing interval:
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: No experience yet available

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 20,000

7. Name and address of person responsible for further information:

Slemr, Dr. Franz
Fraunhofer-Institut für atmosphärische Umweltforschung
(Fraunhofer-Institute for Atmospheric Environment. Research)
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany
Telefax: 49-8821-73573

8. Major bibliographic references, applicable patents, etc.:

- Rudolf, J., Johnen, F.J., Kmedim, A., Pilwat, G.: "The use of automated on-line gaschromatography for the monitoring of organic trace gases in the atmosphere at low levels", Intern. J. Environm. Anal. Chem. 38 (1990) 143-155
- Matuska, P., Koval, M., Seiler, W.: "A high resolution GC-analysis method for determination of C_2 - C_{10} hydrocarbons in air samples", J. High Res. Chromatog. 9 (1986) 577-583

Identification number: 1.24.3. [63]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: A remote monitoring system called Differential Optical Absorbtion Spectrometer (DOAS); the trace gases measured are O_3, SO_2, NO_2, NO_3, HNO_2, HCHO, H_2O, etc.

2. State of development: One year test use

3. Principle of operation: The DOAS system is composed of a high pressure Xenon lamp and a radiation receiver-spectrometer assembly. The signal from the spectrometer is processed in real time using a PC to evaluate the spectral signals and to calculate the concentrations of the pollutants programmed to be monitored by the system. The distance between the radiation source (or the retro-reflector) and the receiver is approximately 2500 meters.

4. **Main technical characteristics:**

4.1 application: Analysis of ambient air
4.2 measuring range: 0 - 500 ppb (planned)
4.3 uncertainty: Planned: Ozone (1 ppb), SO_2 (70 ppt), NO_2 (100 ppt), NO_3 (5 ppt), HNO_2 (100 ppt), HCHO (1 ppb), H_2O (0.1 g/m^3)
4.4 time constant: 3 seconds
4.5 averaging time: 1 - 60 minutes
4.6 reliability: good
4.7 interface and output details: There are analog and serial outputs. When measurements are in progress the following will be displayed and

stored:

1. Substance
2. Length of measurement path
3. Concentration of substance
4. Margin of error
5. Intensity of radiation
6. Current time

4.8 power requirements: ~ 400 W

4.9 servicing interval: Half a year

4.10 other characteristics:

- The DOAS system is working automatically
- The linearity of response is ± 1 %
- The maintenance requirements are:
  · Once a week: System check
  · Once per month: Reference calibration + Backup of data from harddisk
  · Once per half a year: Examination of the system + New certification of all gases

Experiences and other information

5. Experience from comparisons and tests performed: The following should be frequently checked:
- Light levels (if necessary, clean or adjust)
- Deviations (reasonable levels ?)
- Control and cleaning of windows
- Ocular inspection of the whole system (the emitter, the retro-reflector, the receiver, the fiber)

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 50,000

7. Name and address of person responsible for further information:

Martini, Dr. Lothar
Fraunhofer-Institut für atmosphärische Umweltforschung
(Fraunhofer-Institute for Atmospheric Environment. Research)
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany
Telefax: 49-8821-73573

8. Major bibliographic references, applicable patents, etc.:

- Platt, U., and Perner, D.: "Measurements of Atmospheric Trace Gases by Long Path Differential UV/Visible Absorbtion Spectroscopy", in: Optical and Laser Remote Sensing, D.K. Killinger and A. Mooradian, Springer Verlag, Berlin-Heidelberg, New York, 1983
- Neftel, A., Lehmann, B.E., and Lehmann, M.S.: "Monitoring of Peroxides and other Trace Gas Constituents at a High Alpine Station"; preprint, symposium "Physio-chemical Behaviour of Atmospheric Pollutants", Varese, 25-28 September, 1989
- Mount, G.H.: "The Measurement of Tropospheric OH by Long Path Absorbtion, Instrumentation", J. Geophys. Res., Vol. 97, No. D2, pp. 2427-2444, Febr. 20, 1992
- Plane, J.M.C., Nien, C.-F.: "Differential Optical Absorbtion Spectrometer for Measuring Atmospheric Trace Gases", Rev. Sci. Instrum. 63(3), pp. 1867-1876, March 1992.
- Martini, L., Schneider, U., Slemr, F., Werle, P.: "Vergleichsmessungen umweltrelevanter Spurengase: DOAS und konventionelle Meßtechnik"; preprint, Kolloquium der Kommission Reinhaltung der Luft im VDI und DIN "Aktuelle Aufgaben der Meßtechnik in der Luftreinhaltung" vom 02. bis 04. Juni 1993 in Heidelberg.

Other entries related to this category:

1.0.1
1.5.4

1.0. Other

Identification number: **1.0.1** [58]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Water-vapour lidar
2. State of development: Beginning of project postponed
3. Principle of operation: Differential-absorbtion lidar with high-power tunable single-mode laser system (700 - 950 nm)
4. **Main technical characteristics:**

4.1	application:	Measurements of vertical water-vapour density distribution in free troposphere and lower stratosphere
4.2	measuring range:	4 to 13 km above sea level (occasionally higher)
4.3	uncertainty:	±5 % and better
4.4	time constant:	N/A
4.5	averaging time:	1 to 15 min., depending on vert. resolution and range
4.6	reliability:	to be determined
4.7	interface and output details:	PC-controlled data acquisition with transient digitizers and photon counters
4.8	power requirements:	to be determined
4.9	servicing interval:	to be determined

4.10 other characteristics:
- Lidar site located at 2.66 km above sea level.
- Vertical resolution ≤ 0.25 km

Experiences and other information

5. Experience from comparisons and tests performed: N/A
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	unknown

7. Name and address of person responsible for further information:

Trickl, Dr. Thomas
Fraunhofer-Institut für atmosphärische Umweltforschung
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany
Telefax: +49-8821-73573

8. Major bibliographic references, applicable patents, etc.:

Identification number: **1.0.2** [105]

Country: **Poland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Doppler SODAR 50 - 500 m wind vector in a vertical profile
2. State of development: Prototype, laboratory and field tests finished
   first year of operational use: 1992
3. Principle of operation: 3-beam configuration (E-W, N-S, vertical). 2 kHz-0.1 s sound pulse transmission. Reflected signals and noise amplified and

filtered are digital (PC) transformed. Range gate data are averaged (time domain and spectral averaging, ground clutter removed). radial doppler-shift for each specified height along the beam and the vertical components of the wind - calculated by means of ann IBM PC. Manual temperature range correction.

4. **Main technical characteristics:**

4.1	application:	Atmospheric pollution research
4.2	measuring range:	Wind speed:U, V: 0 - 25 m/s, W: ±10 m/s; wind direction: 0 - 360°
4.3	uncertainty:	Wind speed: 0.2 - 0.5 m/s, wind direction: ± 2° - 5°
4.4	time constant:	-
4.5	averaging time:	2, 10, 30, 60 min.
4.6	reliability:	not available
4.7	interface and output details:	RS 232C, IBM PC
4.8	power requirements:	
4.9	servicing interval:	
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: not available yet

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	not available

7. Name and address of person responsible for further information:

Różdżyński, Kazimierz
Sędzickiego 13
81-384 Gdynia
Poland

Telefax:

8. Major bibliographic references, applicable patents, etc.:
Memo only

Other entries related to this category:
1.4.1
1.7.2

2. Instruments put into operational use

2.1. General (pertaining to general requirements of meteorological stations)

Identification number: **2.1.1.** [142]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Codet 2: Allows manual entry of observed meteorological data
2. first year of operational use: 1991
3. Principle of operation: Utilises the standard algorithm and coding practices used in the UK meteorological Office
4. **Main technical characteristics:**

4.1 application: Standardises observations and simplifies training
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability: Very reliable, MTBF > 20,000 hrs
4.7 interface and output details: Standard output or via Modem
4.8 power requirements: Power for Laptop PC and Modem
4.9 servicing interval: N/A
4.10 other characteristics: Meteorological data is entered into the PC using a data entry screen. Entries are checked for range. When OK, complete data is checked for consistency. Transmission is fully automated

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:

Wright, Alan
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom

Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
-

2.2. Weather observations (techniques of observation)

Identification number: **2.2.1.** [33]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Heliograph - to measure automatically the sunshine duration by a tracking system using fibre optics.
2. First year of operational use: 1988
3. Principle of operation: A tracking system using fibre optics with its axis is aligned with respect to the axis of the earth. The aperture angle of 5° × ± 30° allows the measurement of the luminance of the sun with a precision of 10%, for sunshine indication. Sunshine reference: 120 W/m^2.
4. **Main technical characteristics:**

4.1	application:	Automatic sunshine duration measurement
4.2	measuring range:	in units of 1/100 hour
4.3	uncertainty:	With respect to the threshold: ± 10%
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	Tension free impulse contacts
4.8	power requirements:	Autonomous, solar panel
4.9	servicing interval:	1 year
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: International comparison, carried out in Hannover, Germany
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	< US$ 100

7. Name and address of person responsible for further information:
   CIMEL ELECTRONIQUE
   5, Cité de Phalsbourg
   75011 Paris,
   France
   Telefax: (33) 1 43.48.62.61
8. Major bibliographic references, applicable patents, etc.:
   Instruments sheet of Météo France

Identification number: **2.2.2.** [68]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Type: Miriam (Miriam-U)/Tass. Parameters measured: Atmospheric pressure, air and soil temperatures, dew point, relative humidity, wind speed and direction, precipitation (height, duration, status), sunshine (duration, status), visibility, lightning, cloud ceiling (opt.), radiation
2. First year of operational use: 1989
3. Principle of operation: Automatic acquisition of the meteorological sensor

signals (see B.1.); raw signal dat conversion; data processing (parameter checking, -averaging, -summing, determination of extremes and danger levels, data output to monitors, digital cassette, printer/plotters and to a personal computer for further data processing, -storing and -monitoring; transmission of SYNOP (FM12) reports (hourly and special reports (MREP)

4. **Main technical characteristics:**

4.1 application: Depending on parameters, sensors and electronic components

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: Mains, 230 V AC, 50 Hz

4.9 servicing interval: only if system or components fail

4.10 other characteristics: Personal computer (PC) aided microprocessor controlled Automatic Weather Station.

- Sensors for parameters (mentioned in B.1.), with analog and digital output
- Sampling time 0.5 s (wind, sunshine, radiation, status) and 1 min (others)
- Data storage on digital cassette (ECMA 34) every ten minutes for 1 week or 3.5" floppy (optional)
- Analog and digital recording on printers/plotters
- Display of actual values, means, sums,... on monitors and PC
- Full and partial automatic modes; in partial automatic mode the observer supplies the messages with visual originated observations
- Transmission of FM12 - SYNOP and special reports on telex-line

Experiences and other information

5. Experience from comparisons and tests performed: Operational use, after labor. tests and tests in full operation by a weather station were successful

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: -

7. Name and address of person responsible for further information:

Kölbl, Dipl.-Ing. Albert
August-Schmauß-Straße 1
8042 Oberschleißheim
Germany
Telefax: 089-31561813

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.2.3.** [84]

Country: **Hong Kong**

General information

1. Short identification of the instrument including the parameter measured, or its function: Remote video observing system for visibility and weather observations

2. First year of operational use: 1990

3. Principle of operation: Remote transmission of digitized video signals grabbed by a CCTV camera at field station

4. **Main technical characteristics:**

4.1	application:	Remote visibility and weather observations
4.2	measuring range:	Horizontal angle span of 30°; minimum sensitivity of 0.2 Lux
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	Excellent
4.7	interface and output details:	RS 232 for digital video transmission at 9600 bps
4.8	power requirements:	1 kVA
4.9	servicing interval:	1 month
4.10	other characteristics:	N/A

Experiences and other information

5. Experience from comparisons and tests performed: More realistic estimate of visibility than a (back scattering type) videograph does when the visibility is not homogeneous in range

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Approx. US$ 1,000

7. Name and address of person responsible for further information:

Director of the Royal Observatory, attn.: Mr. H.G. Wai,
Royal Observatory,
Nathan Road,
Kowloon,
Hong Kong

Telefax: (+852) 721-5034

8. Major bibliographic references, applicable patents, etc.:

Yeung, K.H. (1992): "A remote video observing system", WMO/CIMO- TECO-92, Vienna, Austria, 11-15 May 1992, WMO Instr. and Observ. Meth. Rep. No. 49 (WMO/TD-No.462), pp. 279

-

Other entries related to this category:

2.5.2
2.10.3
2.22.12

2.3. Measurement of atmospheric pressure

Identification number: **2.3.1.** [12]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: Name of the device: Basic synoptic weather station
   Parameters measured: Temperature, humidity, pressure, wind speed and direction, precipitation, radiation and soil temperature.
2. First year of operational use: 1991
3. Principle of operation: Data collection system collects and processes the data from sensors, and calculates the average, maximum and minimum values. the central computer edits the synoptic report to printout.
4. **Main technical characteristics:**

4.1	application:	Basic meteorological observatory
4.2	measuring range:	—50°C - +50°C ; 10 - 100%RH; 300 - 1060 hPa (arbitrarily 120 hPa); 0 -360°; 0 - 60 m/s (threshold < 0.6 m/s)
4.3	uncertainty:	
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	Analogue, frequency, event counting and numeric.
4.8	power requirements:	220 V AC, ±10%
4.9	servicing interval:	
4.10	other characteristics:	Automatic calibration. Response distance of the vane: < 1 m; damping ratio ≈ 0.4

Experiences and other information

5. Experience from comparisons and tests performed: The system undergoes extensive environmental tests and keeps an accuracy specified over 2 years
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	

7. Name and address of person responsible for further information:
   Chen Xiaoqiang
   Changchun Meteorological Instrument Institute
   1 Qianjin Street,
   Changchum,
   China
   Telefax:
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.3.2.** [14]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: Name of the device: Multipurpose telemetry meteorological system.
   Parameters measured: Temperature, humidity, pressure, wind speed and direction, visibility and cloud height.
2. First year of operational use: 1990

3. Principle of operation: The microcomputer and interface enables collecting and processing of meteorological data and transmitting to the central computer for real time analysis, then distributing to users. Microcomputer, sensor, data communication and processing technologies are adopted.

4. **Main technical characteristics:**

4.1	application:	Civil aviation, nuclear test, agriculture and environment agencies
4.2	measuring range:	—45°C - +45°C; 10 - 100%RH; 800 - 1060 hPa (arbitrarily 100 hPa); 0 - 4 mm/min
4.3	uncertainty:	
4.4	time constant:	
4.5	averaging time:	3 months
4.6	reliability:	
4.7	interface and output details:	Analogue, numeric and pulse output: Printer, CRT display, magnetic disc catalogue
4.8	power requirements:	220 V AC (+10%, —15%)
4.9	servicing interval:	1 year
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: Static accuracy test, environment tests and quality check. the specifications meet requirement of design.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Du Jianjun
Changchun Meteorological Instrument Institute
1 Qianjin Street,
Changchum,
China
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.3.3.** [21]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
- PTB 200 A Digital barometer
- PTB 201 A Digital barometer

2. First year of operational use: 1992

3. Principle of operation: Silicon capacitive absolute pressure sensor. Digital signal conditioning electronics.

4. **Main technical characteristics:**

4.1	application:	AWS pressure transmitter
4.2	measuring range:	600 - 1100 hPa (—40 - +60°C)
4.3	uncertainty:	(Total accuracy) PTB 200 A: ± 0.2 hPa; PTB 201 A: ± 0.3 hPa
4.4	time constant:	1 s (settling time)
4.5	averaging time:	400 ms to 100 s (user defined)
4.6	reliability:	
4.7	interface and output details:	RS 232C or TTL level serial output

4.8 power requirements: 10 - 30 V DC (25 mA)

4.9 servicing interval: Stability check once a year

4.10 other characteristics:

- Long term stability: < ± 0.1 hPa/year
- Operates in continuous, interval or poll mode
- Sleep and shutdown modes for reduced power consumption
- Power supply triggering possibility with TTL level logic signal
- Pulse output option available
- Traceability to NIST, USA.

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Järvi, Pekka
Vaisala Oy,
PL 26
SF-00421 Helsinki,
Finland

Telefax: +358-0-8949485

8. Major bibliographic references, applicable patents, etc.:

Several patents on silicon capacitive pressure technology and on capacitive sensor measurement techniques.

-

Other entries related to this category:

2.22.9

2.4. Measurement of temperature

Identification number: **2.4.1.** [121]

Country: **Switzerland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Thygan, type 2.7: Temperature and humidity
2. First year of operational use: 1987
3. Principle of operation:
   temperature: Thermoelement
   humidity: Hygrometer with dewpoint mirror.
   Completely automatic sensors and status indication.
4. **Main technical characteristics:**
4.1 application: Swiss automatic network
4.2 measuring range: T: 40° ... +45°C; T_d: 65° ... + 40°C
4.3 uncertainty: 0.1°C; 0.1%RH
4.4 time constant: ultrarapid
4.5 averaging time:
4.6 reliability: Mean time between failures: 5 years.
4.7 interface and output details: Microprocessor
4.8 power requirements: 50 V AC and ±6 V DC
4.9 servicing interval: 1 year
4.10 other characteristics:
   - T: Thermoelement Copper/Constantan, ∅ = 0.3 mm
   - U: Dewpoint mirror, Peltier element
   - General: Good experiences, also during extreme conditions (wind, freezing mist)
   - Lightning protection
   - Radiation: Error caused by an radiation of 1500 W/m^2: 0.1°C

Experiences and other information

5. Experience from comparisons and tests performed: very reliable; 0.6% of the data is undefined; 1 failure in 5 years. Comparisons: very good results
6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: Approx. US$ 700
7. Name and address of person responsible for further information:
   Haechler, Patrick
   Institut Suisse de Météorologie (ISM)
   Postfach
   8044 Zürich
   Switzerland
   Telefax: (01) 256 92 78
8. Major bibliographic references, applicable patents, etc.:
   Working reports ISM:
   - No 164, 'Thygan, Beschreibung der Funktion und der Technik'
   - No 170, 'Thygan, Benutzerinformationen und erfahrungen'

Identification number: **2.4.2.** [124]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Temperature sensor Pt 100, model T01 - 5312 - 1110; measures temperatures T and T'.
2. First year of operational use: 1984
3. Principle of operation: Sensor of platinum without self-induction of which the resistance varies linearly as a function of temperature
4. **Main technical characteristics:**

4.1	application:	Meteorology
4.2	measuring range:	—30°C - +50°C
4.3	uncertainty:	±0.1°C
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	
4.8	power requirements:	Mains, 220 V
4.9	servicing interval:	On average every two months

4.10 other characteristics:
- Stability: The sensor shows some irregularities
- Durability: Durable
- Set-up: Sensor is installed on meteorological sites.
- Adjustment: Regularly (every two months)

Experiences and other information

5. Experience from comparisons and tests performed: Take care for regular calibrations.
6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
   Slimi, Ali
   Institut National de la Meteorologie
   B.P. 156
   2035 Tunis-Cartage
   Tunisia
   Telefax: +216-1 784 608
8. Major bibliographic references, applicable patents, etc.:
   -

Other entries related to this category:

2.0.3
2.3.1
2.3.2
2.5.1

2.5. Measurement of humidity

Identification number: **2.5.1.** [23]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: HMP 35D relative humidity and air temperature
2. First year of operational use: 1988
3. Principle of operation:
   - Improved polymer used in the HUMICAP capacitive sensor
   - Improved temperature compensation of measurement electronics
4. **Main technical characteristics:**

4.1	application:	AWS sensor/transducer
4.2	measuring range:	0 - 100 %RH, —60 - +65°C
4.3	uncertainty:	± 2 %RH (0 - 90 %RH), ± 3 %RH (90 - 100 %RH)
4.4	time constant:	< 15 s (with membrane filter) at 20°C , 90 % response.
4.5	averaging time:	
4.6	reliability:	Typical long term stability better than 1 %RH/a
4.7	interface and output details:	RH: 0 - 1 V corresponding 0 - 100 %RH; T: Pt-100 sensor.
4.8	power requirements:	7 - 35 V DC
4.9	servicing interval:	Typically 1 a
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	

7. Name and address of person responsible for further information:
   Mesiä, Heikki
   Vaisala Oy,
   PL 26
   SF-00421 Helsinki,
   Finland
   Telefax: +358-0-8949485
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.5.2.** [54]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Electronic tensiometer 8403. Measurement of soil suction tension by ceramic cell and piezoresistive transducer
2. First year of operational use: 1991
3. Principle of operation: The basic principle of the tensiometer consists in the measurement of the suction due to the response to water requirement in soil. The instrument is compact, of rugged design and characterised by quick response and a integrated amplifier with standard electric signals

4. **Main technical characteristics:**

4.1 application: Agrometeorology, hydrology; Soil moisture measurement

4.2 measuring range: 0 .. —85 kPa

4.3 uncertainty: < 0.5 %FS

4.4 time constant: < 3 s

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: 0 ... 1 V DC or 200 ... 3200 Hz; tube length: 300, 600, 900 mm

4.8 power requirements: 12 ... 24 V DC, 0.5 VA

4.9 servicing interval: determined by refill sequences

4.10 other characteristics:

- air break through > —100 kPa
- temp. coefficient: 0.025 $\%K^{-1}$
- ceramic cell: ∅ 10 mm, height 26 mm

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 5

7. Name and address of person responsible for further information:

Janssen, Dr. Heino
Wilh. Lambrecht GmbH
P.O.B. 26 54
Friedländer Weg 65-67
D-3400 Göttingen

Telefax: 551-49 58 12

8. Major bibliographic references, applicable patents, etc.:

- Timm, M., Seyfarht, M., Quast, J., Lindner, H.: "Tensiometerentwicklung für die bewässerung in Gewächshäusern", Arch. Gartenbau, Berlin 38(1990)8, pp. 533-541
- Timm, M.: "Entwicklung und Fertigung vor Keramikzellen für mobile Feldtensiometer", Arch. Acker-Pflanzenbauu Bodenk., Berlin 33(1989)1, pp. 11-13

Identification number: **2.5.3.** [111]

Country: **Russian Federation**

General information

1. Short identification of the instrument including the parameter measured, or its function: Dew point sensor M-132 for hygrometers and dew-point channels in measuring systems

2. State of development:

First year of operational use:

3. Principle of operation: Use of electrolyte temperature stabilization during triple-point preheating; coiling of conductors on an insulated rod and application of the electrolyte solution

4. **Main technical characteristics:**

4.1 application: Measurement of dew point in land and sea conditions

4.2 measuring range: From —30°C to +32°C

4.3 uncertainty: ±0.5°C in saturation conditions

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: Resistance to direct current 80 - 140 Ω

4.8 power requirements: DC source: Accumulator or battery

4.9 servicing interval: 1 year

4.10 other characteristics: can operate in uninterrupted or interruptable mode

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Instrument R&D Institute
Raskovoi Str. 20
125124 Moscow
Russian Federation

Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:

2.3.1
2.3.2
2.4.1

2.6. Measurement of surface wind

Identification number: **2.6.1.** [13]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Name of the device: Automatic wind measurements system
   Model number: N-DZF
   Parameters measured: Wind speed and direction
2. First year of operational use: 1990
3. Principle of operation: The system comprise transmitting and receiving systems. The transmitting system performs transfer of values measured. The data are processed by a computer and printed out by the receiving system. the parameters measured can be varied according to user requirements (*e.g.* temperature, humidity and pressure)
4. **Main technical characteristics:**

4.1	application:	Remote region, off-shore and other environmental.
4.2	measuring range:	Wind speed: 2 - 60 m/s; wind direction: 0 - 360° (threshold: ≤ 2 m/s)
4.3	uncertainty:	
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	The system is equipped with a radio station. The pulse is converted into AC signal by modem and transmitted.
4.8	power requirements:	The solid state acid accumulator which is recharged by silicon photoelectric generator.
4.9	servicing interval:	1 year

4.10 other characteristics:
- The system is equipped with a electronic and a mechanical clocks. When a electronic one goes wrong, the other will correct it with sync signal between both in 24 hours.
- The system is recharged at half a year and sensors need oiling at half a year.
- It is given means of waterproof, anti corrosion, anti jamming and anti lightning.

Experiences and other information

5. Experience from comparisons and tests performed: The system is tested in a wind tunnel. threshold, measuring range and sensitivities are up to standard.
6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
   Xu Dianyi,
   Changchun Meteorological Instrument Institute
   1 Qianjin Street,
   Changchum,
   China
   Telefax:
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.6.2.** [42]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Anemometer system with deicing (by Laumonier). It measures wind under severe conditions (extreme temperatures and icing).
2. First year of operational use: 1988
3. Principle of operation: Anemometer: Turbine. Very powerful heating system (500 W)
4. **Main technical characteristics:**
- 4.1 application: To measure wind in the mountains
- 4.2 measuring range: 1.5 to 80 m/s
- 4.3 uncertainty: ± 2%; ± 0.5 m/s
- 4.4 time constant: Constant access length: approx. 14 m
- 4.5 averaging time:
- 4.6 reliability: Approved at difficult sites.
- 4.7 interface and output details: Frequency output
- 4.8 power requirements: 220 V (500 to 1000W)
- 4.9 servicing interval: 1 year
- 4.10 other characteristics: For more information: Information sheet from SETIM (No. W8,W01 1332A 0000)

Experiences and other information

5. Experience from comparisons and tests performed: The instrument is used on Mont-Aigoual, France and on alpine sites (especially for the Olympic winter games in Albertville, France in 1992). The system is submitted to the WMO intercomparison of wind measurements.
6. **Costs:**
- 6.1 unit cost at factory:
- 6.2 annual operating costs:
7. Name and address of person responsible for further information:

Lafaysse, Christian
SETIM/QMR/ND
Météo France
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.6.3.** [69]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Miriam-W, type SK 565/SK 566, speed and direction of surface wind
2. First year of operational use: 1984
3. Principle of operation: Single positioned cup anemometer and wind vane with electrically heated surfaces of all moveable and non-moveable components

4. **Main technical characteristics:**

4.1 application: Wind measurement on sites with severe weather conditions

4.2 measuring range: Speed: 0.5 ... 80 m/s; direction: 0 ... 360 deg.

4.3 uncertainty: Speed: 2% at 5 m/s ≤ v ≤ 80 m/s; direction: ± 3.6 deg.

4.4 time constant: Speed, distance constant: L = 7.9 m; direction, damping ratio: D = 0.34

4.5 averaging time: Speed: 0.5 s, dependent on the sample rate; direction: not any

4.6 reliability: Speed/direction, MTBF: 1 year

4.7 interface and output details: Anemometer (speed): Potential-free dc-pulses (0 .. 1200 Hz); Vane (direction): 8 bit parallel in Gray-Excess-3-code.

4.8 power requirements:

Sensor	Anemometer	Vane
Signal	12 V DC / 0.8 W	12 V DC / 3.6 W
Heating	42 V AC / 260 W	42 V AC / 230 W

4.9 servicing interval: 1 year

4.10 other characteristics: A microprocessor controlled data acquisition equipment contains the complete hard- and firmware for input, processing and output of the wind informations.
The instantaneous and the derivated wind values e.g. means, extremes, standard deviations are evaluated by the microprocessor system.
The data are displayed on a monitor and are analogue recorded on a special printerplotter. furthermore, the data are stored on a digital tape recorder.

Experiences and other information

5. Experience from comparisons and tests performed: Before introduction into operational use there were detailed field tests during some winter seasons on three topographically different weather stations (490 m, 1490 m and 2960 m above sea level).

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: -

7. Name and address of person responsible for further information:

Brust, Dipl.-Ing. Hansjörg
Deutscher Wetterdienst
Instrumentenamt München
August Schmauß Straße 1
8042 Oberschleißheim
Germany
Telefax: 089-31561813

8. Major bibliographic references, applicable patents, etc.:

- Deutsches Patent No. 2843124
- Brust, H.: "Bericht über Entwicklung eines heizbaren Schalensternanemometer und einer heizbaren Windfahne", DWD-Bericht DK 551.508.5, Deutscher Wetterdienst - Instrumentamt München, September 1983
- Brust, H., Kölbl, A.: "Development and Test of a Heated Wind Measurement System", Instruments and Observing Methods, DK 551.508.53: 551.508.54, WMO-Report No. 15, July 1984
- Instruments and Observing Methods WMO-report No. 24 (WMO/TD-No. 231) 1987

Identification number: **2.6.4.** [74]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind speed sensor (cup anemometer), Theodor Friedrichs type no. 4033
2. First year of operational use: 1992
3. Principle of operation: Cup anemometer, with light chopper system
4. **Main technical characteristics:**

4.1	application:	AWOS, Navigation, Air Traffic Control, Environmental monitoring
4.2	measuring range:	0.3 ... 60 m/s
4.3	uncertainty:	± 0.3 m/s; at v < 15 m/s: ± 2% fs
4.4	time constant:	Response length: Approx. 4.5 m
4.5	averaging time:	N/A
4.6	reliability:	Maintenance once per year recommended
4.7	interface and output details:	TTL output; optional RS 422
4.8	power requirements:	9 .. 16 V DC; 0.7 mA with 12 V / TTL, 30 mA with 12 V / RS 422
4.9	servicing interval:	Maintenance once per year recommended
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: not yet (own endurance test is running)
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Depending on maintenance facilities

7. Name and address of person responsible for further information:

Lorenzen, Boy
Theodor Friedrichs & Co.
P.O. Box 1105
D-2000 Schenefeld
Germany

Telefax: 040-8304057

8. Major bibliographic references, applicable patents, etc.:
N/A

Identification number: **2.6.5.** [75]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind direction sensor (vane type), Theodor Friedrichs type no. 4140
2. First year of operational use: 1992
3. Principle of operation: Wind vane instrument, with 8 bit Gray code; shaft encoder
4. **Main technical characteristics:**

4.1	application:	AWOS, Navigation, Air Traffic Control, Environmental monitoring
4.2	measuring range:	0.2 ... 60 m/s
4.3	uncertainty:	< 2° ∢
4.4	time constant:	Damping ratio: 0.57
4.5	averaging time:	N/A
4.6	reliability:	Maintenance once per year recommended

4.7 interface and output details: TTL output; optional RS 422
4.8 power requirements: 9 .. 16 V DC; 0.7 mA with 12 V / TTL, 30 mA with 12 V / RS 422
4.9 servicing interval: Maintenance once per year recommended
4.10 other characteristics: Light weight (approx. 0.9 kg)

Experiences and other information

5. Experience from comparisons and tests performed: not yet (own endurance test is running)

6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: Depending on maintenance facilities

7. Name and address of person responsible for further information:
Lorenzen, Boy
Theodor Friedrichs & Co.
P.O. Box 1105
D-2000 Schenefeld
Germany
Telefax: 040-8304057

8. Major bibliographic references, applicable patents, etc.:
N/A

Identification number: 2.6.6. [79]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind speed sensor LISA

2. First year of operational use: 1978

3. Principle of operation: Cup anemometer with contactless pulse sensing by means of a light barrier 40 pulses per revolution. magnetic floating bearings for measuring low wind speeds from 0.1 m/s up to 60 m/s. heating element for whole year measurement.

4. **Main technical characteristics:**

4.1 application: Measurement of horizontal wind speed
4.2 measuring range: 0 ... 60 m/s
4.3 uncertainty: ± 1% from MR
4.4 time constant: wind way: 5 meter
4.5 averaging time: -
4.6 reliability: -
4.7 interface and output details: 40 pulses per revolution. pulse duration approx. 1 ms. Integrated line driver for cable length up to 5000 meter.
4.8 power requirements: Supply voltage 10 - 18 V DC, approx. 20 mA: Approx. 0.3 W for electronic and 12 W for heating
4.9 servicing interval: 4 years
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: Comparison tests made by German Meteorological Service, Instrumentamt, München

6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: -

7. Name and address of person responsible for further information:
Siggelkow, Jens

Eschelweg 4
D-2000 Hamburg 50
Germany

Telefax: (+49) (0)40 - 384620

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.6.7.** [80]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind direction sensor RITA
2. First year of operational use: 1978
3. Principle of operation: Vane direction sensor with contactless sensing by means of 8 bit Gray code light barriers. Small mass of the wind vane and no damping of the vane enables extremely fast time transient response of all turbulences. Heating element for whole year measurement.
4. **Main technical characteristics:**

4.1	application:	Measurement of horizontal wind direction
4.2	measuring range:	1 ... 360 degree
4.3	uncertainty:	± 2 degree
4.4	time constant:	Measures from 0.1 m/s
4.5	averaging time:	-
4.6	reliability:	-
4.7	interface and output details:	8 bit Gray code with integrated parallel to serial converter
4.8	power requirements:	Supply voltage: 13 - 18 V DC, approx. 150 mA: Approx. 3 W for the electronics and 12 W for the heating
4.9	servicing interval:	4 years
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: Comparison tests made by German Meteorological Service, Instrumentamt, München
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	-

7. Name and address of person responsible for further information:
Siggelkow, Jens
Eschelweg 4
D-2000 Hamburg 50
Germany

Telefax: (+49) (0)40 - 384620

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.6.8.** [81]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Wind speed and direction sensor ULLA
2. First year of operational use: 1988
3. Principle of operation: Measuring of speed and direction with ultra-sonic-waves. The wind component slow down of speed up the acoustic waves send from a ultrasonic transmitter to a receiver. These time differences are computed to speed and direction
4. **Main technical characteristics:**

4.1	application:	Measurement of the horizontal wind speed and direction
4.2	measuring range:	0 ... 50 m/s, 1 ... 360 degrees
4.3	uncertainty:	Logging accuracy: ± 0.2 m/s, mean deviation: ± 2%, angle deviation: ± 5%
4.4	time constant:	50 Hz
4.5	averaging time:	6 seconds, 2 minutes, 10 minutes
4.6	reliability:	-
4.7	interface and output details:	RS 422 data telegram
4.8	power requirements:	Supply voltage 24 V DC, approx. 0.7 A: Approx. 5 W for the electronic and 12 W for the heating
4.9	servicing interval:	
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	-

7. Name and address of person responsible for further information:
   Siggelkow, Jens
   Eschelweg 4
   D-2000 Hamburg 50
   Germany
   Telefax: (+49) (0)40 - 384620
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.6.9.** [90]

Country: **Malaysia**

General information

1. Short identification of the instrument including the parameter measured, or its function: Vaisala WA21 Wind Measuring System. Function: Measuring wind direction and speed (surface wind)
2. First year of operational use: ...
3. Principle of operation: The measurement of wind speed is performed by a low-threshold optoelectronic anemometer which generates a pulse output from a phototransistor. the wind direction is measured by a counter-balanced low threshold optoelectronic wind vane of which the output is a gray-code 6 bit parallel.
4. **Main technical characteristics:**

4.1	application:	Measurement of wind speed and direction

4.2 measuring range: Speed: 0.4 to 75 m/s; direction: 0 - 360 degree
4.3 uncertainty: -
4.4 time constant: -
4.5 averaging time: 1 second
4.6 reliability: not measured yet
4.7 interface and output details: -
4.8 power requirements: 220 V AC, 50 Hz
4.9 servicing interval: Monthly
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: Nil

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 5,500 (estimate, equipment still under warrantee)

7. Name and address of person responsible for further information:
Vaisala OY
PL 26
SF-00421 Helsinki
Finland
Telefax: 358-0 8949227, 358-0 8949338

8. Major bibliographic references, applicable patents, etc.:
Nil

Identification number: 2.6.10. [135]

Country: United States of America

General information

1. Short identification of the instrument including the parameter measured, or its function:
Wind Monitor - Vane Oriented Propeller: Anemometer for surface wind measurements. There are four models for specific applications:
- 05103 wind monitor: (General monitoring applications)
- 05106 wind monitor-MA: Marine applications
- 05305 Wind monitor-AQ: Air quality applications
- 05701 Wind monitor-RE: Research applications

2. First year of operational use:
05103 wind monitor: 1985;
05106 wind monitor-MA: 1992;
05305 Wind monitor-AQ: 1988;
05701 Wind monitor-RE: 1989

3. Principle of operation: Helicoid propeller anemometer with magnetically induced frequency output signal. Vane with conductive plastic potentiometer.

4. **Main technical characteristics:**

4.1 application:
- 05103 wind monitor: Meteorology, transportation, emergency response
- 05106 wind monitor-MA: Oceanography, buoys, ships and workboats
- 05305 Wind monitor-AQ: Air quality, air pollution monitoring, util.
- 05701 Wind monitor-RE: Meteorological research

4.2 measuring range: Wind direction: 0 - 360° mechanical (355° electrical),
wind speed: Nos. 05103 & 05106: 0-60 m/s, no. 05305: 0-40 m/s, no. 05701: 0-30 m/s.

4.3 uncertainty: Wind speed: 0.5 m/s; wind direction: ±5°

4.4 time constant: Propeller distance constant: 1.0 - 2.7 m; vane

delay distance: 0.8 - 1.3 m

4.5 averaging time: N/A

4.6 reliability: MTBF (mean time before failure): 3 yrs

4.7 interface and output details:

- Wind speed output: Sine wave-frequency proportional to wind speed (self generated-magnetically induced)
- Wind direction output: Analog voltage proportional to azimuth angle (excitation voltage required)
- Interfaces to several digital display units with voltage outputs and RS-232 outputs. Also interfaces to most commercially available data loggers.

4.8 power requirements: 5 to 15 V DC for potentiometer excitation

4.9 servicing interval: Annually. Quarterly service recommended when practical.

4.10 other characteristics:

- Rugged yet sensitive with good resolution
- Lightweight corrosion resistant construction
- Design simplicity with minimum service requirements
- Cost effective

Experiences and other information

5. Experience from comparisons and tests performed: Over 13,000 units in use worldwide since introduction. Included in field intercomparison currently in progress at U.K. Met. Office, Beaufort Park, Berkshire. Included in W.M.O. wind sensor intercomparison project currently in progress at Meteo-France Meteorological Observatory at Mont Aigoual.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Approx. US$ 100 (with routine maintenance)

7. Name and address of person responsible for further information:

Campbell, John
R.M. Young Company
2801 Aero-Park Dr
Traverse City, MI 49684
U.S.A.

Telefax: 616-946-4772

8. Major bibliographic references, applicable patents, etc.:

- Michelena, E., Holmes, J. (1983): "A Rugged, Sensitive, and Lightweight Anemometer Used by NDBC for Marine Meteorology", Preprints, Fifth Symposium on Meteorological Observations and Instrumentation, Toronto, American Meteorological Society, 1983, 8 pp.
- Michelena, E.D., Holmes, J.F. (1986): "The Meteorological Sensors Used by the National Data Buoy Center", Proceedings MDS'86 Marine Data Systems International Symposium, New Orleans, Marine Technology Society, 1986, pp. 596-601
- "Anemometer Comparison Project / A Report to the Atmospheric Environment Service of Canada", RVI/50.09, Resource Ventures Incorporated, Charlottetown, Prince Edward Island C1A 3W2, Canada, 1986.
- Weller, R.A., Hosom, D.S. (1989): "Improved Meteorological Measurements from Buoys and Ships for the World Ocean Circulation Experiment", Proceedings Oceans '89, Seattle, IEEE, 1989, pp. 1410-1415
- Weller, R.A., Donelan, M.A. Briscoe, M.G., Huang, N.E. (1991): "riding the Crest: A Tale of Two Wave Experiments", Bull. Amer. Meteor. Soc., Vol. 72, No. 2 (1991) pp. 163-183
- Jones, D.W., Hatton, D.B., Jenkins, D.A., Scott, A.P. (1992): "A Field Intercomparison of Some Wind Sensors", Report No. 49, WMO Technical Conference on Instruments and Methods of Observation (TECO-92), Vienna, 1992, pp. 347-350 (WMO/TD - No. 462)
- Heimo, A., Hoegger, B. (1992): "The new wind sensor test facility

at the Aerological station of the Swiss Meteorological Institute", Report No. 49, WMO Technical Conference on Instruments and Methods of Observation (TECO-92), Vienna, 1992, pp. 361-365 (WMO/TD - No. 462)

Other entries related to this category:

2.3.1

2.3.2

2.7. Measurement of precipitation

Identification number: **2.7.1.** [11]

Country: **China**

General information

1. Short identification of the instrument including the parameter measured, or its function: Model SL1 Tipping Bucket Rain Gauge. It is used for measuring the rainfall
2. First year of operational use: 1979
3. Principle of operation: This instrument is designed for measuring rainfall. There are three tipping buckets in it. They are the first bucket, the second bucket and the third bucket. when the rainfall amount to 0.1 mm, these buckets are tippet. At the third tipping bucket a magnet contained within the bucket moulding. the pulse thus are emitted, according to the rainfall which can be counted.
4. **Main technical characteristics:**

4.1 application:
4.2 measuring range: 0.1 - 0.4 mm/min
4.3 uncertainty: 0.4 mm (under 10 mm); 4% (above 10 mm)
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details: Digital output
4.8 power requirements: 220 V AC, 50 Hz or 12 V DC.
4.9 servicing interval:
4.10 other characteristics:

- Resolution: 0.1 mm
- Remote distance: 100 m

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:

Sun Jinyuan
Dept. of Technical Facilities
State Meteorological Administration
46, Baishiqiaolu,
Beijing 100081,
China
Telefax:

8. Major bibliographic references, applicable patents, etc.:

-

Identification number: **2.7.2.** [25]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: DRD 11 A Precipitation Detector
2. First year of operational use: 1990
3. Principle of operation: Capacitive detection of signal change due to droplets, heating for melting snow.

4. **Main technical characteristics:**

4.1 application: Precipitation occurrence and estimation of rain intensity

4.2 measuring range: 0.05 cm^2 wet area

4.3 uncertainty: N/A

4.4 time constant: Less than 5 minutes after cessation

4.5 averaging time: N/A

4.6 reliability: N/A

4.7 interface and output details: Milos 200 or 500 with an algorithm can be used for estimation of rain intensity

4.8 power requirements: 2.5 max, 0.5 typical

4.9 servicing interval: Annual checking

4.10 other characteristics:

- Can be used for estimation of rain intensity classes, e.g. light, moderate or heavy
- Snow intensity as water equivalent

Experiences and other information

5. Experience from comparisons and tests performed: Rain intensity useful for road maintenance crews at remote locations

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:

Haavasoja, Taisto
Vaisala Oy
PL 26
SF-00421 Helsinki,
Finland

Telefax: +358-0-8949227

8. Major bibliographic references, applicable patents, etc.:
N/A

Identification number: 2.7.3. [76]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: Rain detector sensor, Theodor Friedrichs type no. 7001

2. First year of operational use: 1991

3. Principle of operation: Infrared light barrier system, with intelligent evaluation electronics, supplying precipitation "Yes/No"-signal

4. **Main technical characteristics:**

4.1 application: AWOS, Hydrology, Road authorities, Environmental monitoring

4.2 measuring range: Any type of precipitation: Yes/No

4.3 uncertainty: Threshold drop size approx. 300 µm

4.4 time constant: N/A

4.5 averaging time: Gliding; adjustable

4.6 reliability: Automatic alarm, if cleaning is necessary

4.7 interface and output details: 3 channels open collector

4.8 power requirements: 15 ... 40 V DC; 50 mA with 24 V

4.9 servicing interval: Occasional cleaning; interval normally > 6 months

4.10 other characteristics:

Instrument 7001 features the following outputs:

1 "Drop" =	Every drop passing the light barrier is considered
2 "Rain-yes/no" =	Rain=yes is stated if a certain amount of drops (for example 2) is detected within a certain time (for example 1.5 min)
3 "Emitter status" =	Alarm, if the LED power decreases under a certain limit, i.e. there is too much dust on the screen; screen has to be cleaned.

Experiences and other information

5. Experience from comparisons and tests performed: Test at Swedish Air Force 1992 and German Weather service 1992, with good results.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Depending on maintenance facilities

7. Name and address of person responsible for further information:

Lorenzen, Boy
Theodor Friedrichs & Co.
P.O. Box 1105
D-2000 Schenefeld
Germany
Telefax: 040-8304057

8. Major bibliographic references, applicable patents, etc.:
N/A

Identification number: 2.7.4. [86]

Country: Hong Kong

General information

1. Short identification of the instrument including the parameter measured, or its function:
Rainfall Data Acquisition System, version 2.

2. First year of operational use: November 1992

3. Principle of operation: Rainfall measured by each of the 20 tipping-bucket raingauges in the system is coded by a single-chip microcontroller and transmitted every 5 minutes via a public packet switching network to a central 386 microcomputer which processes the data to give tabular display on a video and on a printer. the microcomputer is also linked to a main computer for data archive.

4. **Main technical characteristics:**

4.1 application: To measure depth of rainfall

4.2 measuring range: 0.5 mm/h to 900.0 mm/h

4.3 uncertainty: 0.5 mm

4.4 time constant: 0.5 mm in 2 seconds

4.5 averaging time: N/A

4.6 reliability: good

4.7 interface and output details:
- two RS-232C serial communication ports
- one Centronics parallel port for printer
- one VGA graphic adaptor interface
- one monochrome graphic adaptor interface
- 0ne 3½" 1.44 MByte floppy disk drive for data archive

4.8 power requirements: Central station: 220 V AC, 250 W; Field station: 220 V AC, 10 W

4.9 servicing interval: Twice a month

4.10 other characteristics:

Backlog facilities:
- When the telephone line fails to connect, each field station can store up to three 5-minute rainfall data and transmit them as backlog data once the line is through
- Should the operation of the main computer be disrupted, the central station of the system can store up to 12 hours of rainfall data (5-minute rainfall from a total of 20 field stations) and transmit them as backlog data after the main computer is back to normal.

Experiences and other information

5. Experience from comparisons and tests performed: Rainfall data collected were checked against data obtained from conventional rain gauges and were found to be reliable.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 10,500 (excluding staff and electricity costs but including US$ 9,000 telephone line rental)

7. Name and address of person responsible for further information:
Director of the Royal Observatory, attn.: Mr. B.Y. Lee
Royal Observatory,
134A Nathan Road,
Kowloon,
Hong Kong

Telefax: (+852) 721-5034

8. Major bibliographic references, applicable patents, etc.:
- Lee, B.Y. (July 1984): "A Real-time Rainfall Data Acquisition System", Royal Observatory Technical Note No. 72
- Yeung, K.H., Ng, K.K., Yuen, F.T. (Dec. 1989): "An Automatic Raingauge System", Royal Observatory Technical Note No. 82

Identification number: 2.7.5. [122]

Country: Sweden

General information

1. Short identification of the instrument including the parameter measured, or its function: IS200W rain Gauge

2. First year of operational use: 1992

3. Principle of operation: Weighing gauge with new type of wind shield. Low threshold, since the collecting funnel is included in measurement.

4. **Main technical characteristics:**

4.1 application: Measurement of rain intensity and/or accumulated rain.

4.2 measuring range: 0 - 200 mm, with autosiphon.

4.3 uncertainty: Resolution 0.02 - 0.1 mm, depending of meas. equipm., 0.5% of weight increase during shower, + wind error (see 4.10)

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: Full bridge load cell, 2 mV/V

4.8 power requirements:

4.9 servicing interval: 6 months (Calibration check)

4.10 other characteristics: The design is based on a patented wind shield (see 8. References). the wind error is small, but remain to be specified in detail by comparison with ground reference gauge under different conditions.

Experiences and other information

5. Experience from comparisons and tests performed: Long term stability of load cell sensitivity is better than 0.5%/6 months, as judged from the first series of gauges used in 1992.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Norén, Bengt
In Situ Instruments
Komyravägen 9
S-816 00 Ockelbo
Sweden

Telefax: +46 297 42577

8. Major bibliographic references, applicable patents, etc.:

- Lindroth, A. (1991): "Reduced Loss in Precipitation Measurements using a New Wind Shield for Rain Gauges", Journal of Atmospheric and Oceanic Technology, vol. 8, no. 3, June 1991.
- European Patent no. 0295260
- US Patent No. 4 895 022

Identification number: 2.7.6. [123]

Country: Sweden

General information

1. Short identification of the instrument including the parameter measured, or its function:
Weather station with optical precipitation sensor and freezing point sensor.

2. First year of operational use:
- Precipitation and freezing point sensors, both: 1992;
- Weather station: 1983

3. Principle of operation:
- Optical precipitation sensor: Particles shadowing a lightbeam
- Freezing point sensor: Heats and cools fluid to determine fr. point.
- Entire weather station with several configurations.

4. **Main technical characteristics:**

4.1	application:	Weather monitoring; precip. and freezing point measurements
4.2	measuring range:	- Precipitation: Rain/snow; - Freezing point sensor: Dry/wet/ice
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	N/A
4.7	interface and output details:	N/A
4.8	power requirements:	- Weather station: 220/110 V; - prec. and freez. point sensor: 12 V
4.9	servicing interval:	1 year for station and sensors
4.10	other characteristics:	(see 8.)

Experiences and other information

5. Experience from comparisons and tests performed: Sensors and station tested by National Swedish Road Adm. and universities. Weather station is use for several years

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:

Sahlin, Lars
Box 360
831 25 Östersund
Sweden

Telefax: +46 63156301

8. Major bibliographic references, applicable patents, etc.:

Sensors: Patents in USA and Europe

Identification number: **2.7.7.** [125]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function:

Pluviometer transducer based on pulse counting with remote control by tipping buckets, model R01 - 3030

2. First year of operational use: 1984

3. Principle of operation: For toppling a quantity of 20 g water is necessary (using a reception reservoir of 1000 cm^2)

4. **Main technical characteristics:**

4.1 application: Meteorologie, climatology and agriculture

4.2 measuring range:

4.3 uncertainty: ±4%

4.4 time constant:

4.5 averaging time:

4.6 reliability: reliable

4.7 interface and output details:

4.8 power requirements: 12 V

4.9 servicing interval: Maintenance every three months

4.10 other characteristics:

- Long term stability, precise, durable
- necessary regular maintenance every three months

Experiences and other information

5. Experience from comparisons and tests performed: Very useful

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Slimi, Ali
Institut National de la Meteorologie
B.P. 156
2035 Tunis-Cartage
Tunisia

Telefax: +216-1 784 608

8. Major bibliographic references, applicable patents, etc.:

-

Other entries related to this category:

2.3.1, 2.3.2
2.10.3

2.8. Measurement of evaporation

Identification number: **2.8.1.** [77]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Electronic Evaporation Meter, to measure evaporation rate at free surfaces of water (lakes, reservoirs etc.), Theodor Friedrichs type no. 7061
2. First year of operational use: 1992
3. Principle of operation: System mounted on buoys with anchors, measuring wind speed (1 m), rel. humidity (1 m), air temp. (1 m) and surface water temp., calculating evaporation by means of Dalton equation.
4. **Main technical characteristics:**

4.1	application:	Meteorology, Hydrology, Agriculture, Reservoir management
4.2	measuring range:	N/A
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	10 min. av. calculation, 1 h av. data storage
4.6	reliability:	N/A
4.7	interface and output details:	Data storage on solid state memory card; RS 232 interface
4.8	power requirements:	Approx. 22 mA / 12 V DC; battery supplied
4.9	servicing interval:	Battery change after 12 days; optionally solar panel
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: A number of publications by Prof. J. Werner, Univ. of Münster, Germany, concerning the previous model
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Depending on maintenance facilities

7. Name and address of person responsible for further information:
   Lorenzen, Boy
   Theodor Friedrichs & Co.
   P.O. Box 1105
   D-2000 Schenefeld
   Germany
   Telefax: 040-8304057
8. Major bibliographic references, applicable patents, etc.:
   (Previous model:)
   Werner, J. (1987): "Ein neues schwimmendes Meßsystem zur automatischen Verdunstungsbestimmung an stehenden Gewässern" ("A new floating measuring system for the automatic determination of the evaporation of ponded water bodies"), Meteorol. Rundschau, 40. Jahrgang, Heft 1, Febr. 1987

2.9. Measurement of radiation

Identification number: **2.9.1.** [19]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   - Kipp & Zonen, CM11, Global radiation pyranometer
   - Kipp & Zonen, CM11, Diffuse radiation pyranometer
   - Kipp & Zonen, CM11, Reflected radiation pyranometer
2. First year of operational use: 1990
3. Principle of operation: Diffuse radiation measured with shadowring
4. **Main technical characteristics:**

4.1	application:	Measurement of solar radiation
4.2	measuring range:	0 - 1000 W/m^2
4.3	uncertainty:	Secondary standard
4.4	time constant:	24 s
4.5	averaging time:	1 hour
4.6	reliability:	
4.7	interface and output details:	IBM compatible PC with data acquisition board
4.8	power requirements:	N/A
4.9	servicing interval:	National comparisons / 1 year
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: International and national comparisons
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	-

7. Name and address of person responsible for further information:
   Laitinen, Leila; meteorologist
   PL 503 (Vuorikatu 24),
   00101 Helsinki,
   Finland
   Telefax: (+358 0) 179581
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.9.2.** [32]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Automatic photometer to follow the sun. To measure the optical thickness of the atmosphere. To Measure the luminance of the sky.
2. First year of operational use: 1992
3. Principle of operation: The photometer is supported by azimuth controlled mount (equation of time + sun follower) evaluates the optical properties of the atmosphere within 8 spectral channels (continuous , for aerosols, for water vapour and for ozone).
   With the help of auto calibration measurements are realized and the measure of luminance of the sky are produced according to normalized schemes.

4. **Main technical characteristics:**

4.1 application: Detection of forest fire, transport of aerosols, precipitable water, correction of satellite images, etc.

4.2 measuring range: 0 - 1500 W/m^2

4.3 uncertainty: 1.1% for luminance (same as U.S. standard), 0.1°C for the detector temperature.

4.4 time constant:

4.5 averaging time:

4.6 reliability: The construction is prepared for implant in arid or tropical zones.

4.7 interface and output details: Memory cartridge, serial interface, DCP interface.

4.8 power requirements: Autonomous

4.9 servicing interval: 1 year

4.10 other characteristics: This instrument is developed by three groups of specialists on models of the representation of the optical properties of the atmosphere (CNED - CNRE/LOA - NASA GODDARD). Its purpose is besides the classical functions to measure the optical thickness by observing the sun, to produce the data necessary for the precise corrections of satellite images and for interpretation of these, according to nowadays scientific criteria.
The instrument is completely automatic, provided with a auto calibration facility.
In addition it is impenetrable for water and sandy wind and thus suitable to equip observing networks.

Experiences and other information

5. Experience from comparisons and tests performed: Comparable result with U.S. standards (TURSON University, Arizona, U.S.A.)

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 1,000 + US$ 2,000 every five years

7. Name and address of person responsible for further information:
CIMEL ELECTRONIQUE
5, Cité de Phalsbourg
75011 Paris,
France
Telefax: (33) 1 43.48.62.61

8. Major bibliographic references, applicable patents, etc.:
- Evaluation report, to be published.

Identification number: **2.9.3.** [34]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Pyranometer with thermopile, type white-black monocouple. Measurement of global radiation.

2. First year of operational use:

3. Principle of operation: A thermopile sensor shaped as a drawknife consists of thermocouples which a places around and provided with an absorber and a diffuser for the range 300 - 2600 nm.

4. **Main technical characteristics:**

4.1 application: Measurement of global radiation

4.2 measuring range: 0 -1400 W/m^2
4.3 uncertainty: 3%
4.4 time constant: up to 1/e: 7 s
4.5 averaging time:
4.6 reliability:
4.7 interface and output details: Voltage output 0 ≈ 10 mV
4.8 power requirements: Nothing
4.9 servicing interval: 1 year
4.10 other characteristics: The particular disposition and the choice of the materials permit protection against night inversion and the effect caused by azimuth and altitude.

Experiences and other information

5. Experience from comparisons and tests performed: A comparison is carried out at the Laboratoire d'Actinothermie in Carpentras, France.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
CIMEL ELECTRONIQUE
5, Cité de Phalsbourg
75011 Paris,
France

Telefax: (33) 1 43.48.62.61

8. Major bibliographic references, applicable patents, etc.:
Instruments sheet of the Météorologie Nationale Française

Identification number: 2.9.4. [49]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function: Global Radiation Reference Radiometer (GRRR) for high precision measurement of global, direct and diffuse solar radiation.

2. State of development:
First year of operational use: 1990

3. Principle of operation: Compact instrument system which uses one single solar tracker for both an absolute pyrheliometer (Eppley model H-F) and a disk shading the sun from a selected pyranometer (Kipp & Zonen model CM 11) for measuring the diffuse solar radiation. Global solar radiation is calculated by the computer of the data acquisition system.

4. **Main technical characteristics:**

4.1 application: Solar collector tests, outdoor characterization or comparison of pyranometers
4.2 measuring range: 0 - 1200 W/m^2
4.3 uncertainty: 1% RMS for global radiation at fine weather stations
4.4 time constant: < 5 s
4.5 averaging time: usually 10 min.
4.6 reliability: high (precise adjustments provided)
4.7 interface and output details: Control unit for operating the pyrheliometer; analogue outputs (1 mV; 5 mV; 3 V)
4.8 power requirements: 220 V, 50 Hz (< 220 VA, without data acquisition)
4.9 servicing interval: daily
4.10 other characteristics:

- disk-shaded view angle at the pyranometer receiver: 5° (equal to the field of view of the receiver)
- automatic zeroing of the pyrheliometer
- pyranometer selected according to low cosine errors
- special zero cap to determine pyrano-zero
- equatorial mount with synchronous motor drive

Experiences and other information

5. Experience from comparisons and tests performed: Intercomparison of global radiation reference radiometer systems: 1990 at Norrköping, Sweden and 1991 at Toronto, Canada.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: < US$ 500

7. Name and address of person responsible for further information:

Dehne, Klaus
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:
Dehne, K., Lieduist, L., Dahlgren, L.: "IEA Global Radiation Reference Radiometer Comparison", in: "WRC/PMOD: International Pyrheliometer Comparison IPC VII (24 Sept to 12 Oct 1990). Results and Symposium. Working Report No. 162", Swiss Meteorological Institute, Davos and Zürich.

Identification number: **2.9.5.** [52]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Solar Time Clock HAL-SOL/1.0, true solar time clock to control measurements referring to the local apparent time, as required for measurements of solar radiation (according to WMO Guide No. 8, 1983, Ch. 9.4.1).

2. First year of operational use: 1989 (Solar Radiation Network of Jordan)

3. Principle of operation: Microcomputer-operated real time clock with liquid crystal display. The geographical longitude is set by dip-switches. The clock is set by push-buttons to local standard time. The true solar time is calculated and displayed. Output pulses are generated at user-defined intervals (6, 10, 30 or 60 minutes, and 12 or 24 hours true solar time), to trigger printing integrators etc. or to produce time marks on strip chart recorder.

4. **Main technical characteristics:**

4.1	application:	To synchronize electronic integrators and/or recorders with true solar time
4.2	measuring range:	N/A
4.3	uncertainty:	Less than +30 seconds within leap year cycle, provided the clock is set correctly.
4.4	time constant:	N/A
4.5	averaging time:	N/A
4.6	reliability:	Real time clock is battery buffered for several weeks
4.7	interface and output details:	2 opto-coupler outputs for control pulses

4.8 power requirements: 6 to 24 V DC, consumption approx. 100 mW at 6V
4.9 servicing interval: not specified
4.10 other characteristics:
- Hardware: Front plate approx. 100 × 130 mm;
- Printed circuit board: 100 × 160 mm for installation in 19" racks
- Output pulses programm may be adapted to user specifications.

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: negligible

7. Name and address of person responsible for further information:

Bergholter, Uwe
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95,
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:

Identification number: 2.9.6. [53]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function:
Radiation data acquisition system, model MEISE 3. Parameters measured: Global and diffuse solar radiation, atmospheric radiation, instrument temperature (of the Pyrgeometer), sunshine duration

2. First year of operational use: 1990

3. Principle of operation: Computer-controlled acquisition of solar and terrestrial irradiance sensor signals, analog/digital data conversion, averaging, integrating, sorting, error control, data output to monitor, digital diskette, printer.

4. **Main technical characteristics:**

4.1 application: Recording solar and terrestrial radiation flux densities
4.2 measuring range: usual range for radiation quantities
4.3 uncertainty: depending on sensor quality
4.4 time constant: N/A
4.5 averaging time: 1 hour or defined by user
4.6 reliability: high
4.7 interface and output details: A/D converter resolution: 12 bits
4.8 power requirements: mains, 230 V AC, 50 Hz
4.9 servicing interval: operation check monthly (disk change)
4.10 other characteristics:
- sensor signal analog and digital output
- sampling time 10
- data storage on digital diskette (5¼") every hour (UTC and local time)
- analog signal out to strip chart recorder
- display of actual irradiances on monitor
- display of hourly and daily sums of radiation up to 5 days on monitor
- Software: Basic programm

Experiences and other information

5. Experience from comparisons and tests performed: Operational use after laboratory tests

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: -

7. Name and address of person responsible for further information:
Czeplak, Gerhard
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95,
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:
Kasten, F., Dehne, K., Behr, H.D., Bergholter, U.: "Die räumliche und zeitliche Verteilung der diffusen und direkten Sonnenstrahlung in der Bundesrepublik Deutschland. BMFT Forschungsbericht T84-125, Hamburg (1984).

Identification number: 2.9.7. [95]

Country: Netherlands

General information

1. Short identification of the instrument including the parameter measured, or its function:
Pyrgeometer CG1 for measurement of long wave radiation, 3 - 50 micron

2. First year of operational use: 1989

3. Principle of operation: Thermopile detector. Filtering by silicon window with interference filter. A Pt100 is incorporated for sensor temperature measurement. Heating to keep the pyrgeometer above dewpoint. Necessary for read-out: mV, Pt100, Data acquisition.

4. **Main technical characteristics:**

4.1 application: Climatology, evaporation estimation, cloud observation

4.2 measuring range: Plus or minus 250 W/m^2

4.3 uncertainty: 10% plus window heating offset

4.4 time constant: 55 sec. (99%)

4.5 averaging time: Not specified

4.6 reliability: Not specified

4.7 interface and output details: One mV channel and one Pt100 channel

4.8 power requirements: 1 W when heating is used

4.9 servicing interval: Daily (recommended)

4.10 other characteristics: A net (double) version is available.

Experiences and other information

5. Experience from comparisons and tests performed:
- A prototype participated in the BSRN Broadband IR Radiometer Intercomparison at Coffeyville, Kansas, Nov. 13th - Dec. 7th, 1991.
- Operational use at KNMI, the Netherlands since 1992.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Negligible

7. Name and address of person responsible for further information:
Van den Bos, C.J.
Kipp en Zonen Delft B.V.

Mercuriusweg 1
Delft,
Netherlands

Telefax: +31-15-620351

8. Major bibliographic references, applicable patents, etc.:
N/A

Identification number: **2.9.8.** [96]

Country: **Netherlands**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Pyrheliometer CH1 for measurement of direct solar radiation.
Slope angle 1 degree. opening angle 5 degrees.

2. First year of operational use: 1992

3. Principle of operation: Thermopile detector. Weatherproof metal housing which determines opening and slope angle. Quartz window. MilliVolt output.

4. **Main technical characteristics:**

4.1 application: Climatology
4.2 measuring range: up to 2000 W/m^2
4.3 uncertainty: Approx. 2%
4.4 time constant: 12 sec. (99%)
4.5 averaging time: Not specified
4.6 reliability: Not specified
4.7 interface and output details: MilliVolt output
4.8 power requirements: None
4.9 servicing interval: Daily (recommended)
4.10 other characteristics:
- First instrument in accordance with WMO specs.
- Options: Filters for spectral measurements.

Experiences and other information

5. Experience from comparisons and tests performed: Australian Meteorological Service performs prototype tests.

6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: Negligible

7. Name and address of person responsible for further information:
Van den Bos, C.J.
Kipp en Zonen Delft B.V.
Mercuriusweg 1
Delft,
Netherlands

Telefax: +31-15-620351

8. Major bibliographic references, applicable patents, etc.:
N/A

Other entries related to this category:
2.3.1
2.3.2
2.21.3

2.10. Measurement of visibility

Identification number: **2.10.1.** [20]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Transmissometer MITRAS: Transmittance of atmosphere, MOR.
2. First year of operational use: 1987
3. Principle of operation: Pulsed xenon light source TX, Light intensity measurement I(Rx)/I(Tx)
4. **Main technical characteristics:**

4.1	application:	T, MOR, RVR
4.2	measuring range:	T = 0.01 - 0.998, MOR = 10 m - 10,000 m
4.3	uncertainty:	≤ ± 0.01 of T
4.4	time constant:	1 sec
4.5	averaging time:	30 sec/60 sec
4.6	reliability:	MTBF > 8000 h
4.7	interface and output details:	RS 232, modem CCITT V21
4.8	power requirements:	250 W + 250 W
4.9	servicing interval:	≥ 1 month

4.10 other characteristics:
- background luminance measurement
- window contamination measurement/compensation
- stability check every 6 months
- linearity check every 12 months (≤ ± 1%)

Experiences and other information

5. Experience from comparisons and tests performed: Ref. WMO Instr. & Obs. Meth. report no. 41, intercomparison of visibility measurements
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	(Window cleaning)

7. Name and address of person responsible for further information:

Kortlahti, Harri
Vaisala Oy,
PL 26
00421 Helsinki,
Finland
Telefax: +358-0-8949227

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.10.2.** [27]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: FD12 Forward scatter visibility meter
2. First year of operational use: 1989
3. Principle of operation: Forward scatter, near-IR LED, precipitation; particle detection and correction
4. **Main technical characteristics:**

4.1	application:	MOR measurement for AWS, RVR, etc.

4.2 measuring range: 20 m - 20 km (-50km/AVE 10 min)
4.3 uncertainty: ± 20%
4.4 time constant: 15 s meas. cycle 4 last cycles = instant
4.5 averaging time: 1 min 10 min (extinction)
4.6 reliability: MTBF (predicted) > 12,000 h
4.7 interface and output details: Serial line (RS 232, RS 485, V.21). Several message formats; analog 4 - 20 mA; configurable range; two alarm limits.
4.8 power requirements: 50 W (200 W with head heaters)
4.9 servicing interval: Lens cleaning when dirty (alarmed by the device)
4.10 other characteristics:
- Extensive self check. Contamination monitoring of optics.
- Display unit (FDC21) and recorder (DR21)
- MITRAS transmissometer emulation (message) mode

Experiences and other information

5. Experience from comparisons and tests performed: Developed and monitored against Vaisala MITRAS transmissometer. Consistency tested between 6 units. FAA approved. FMI comparison with human observer (Valkovuori)

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: Marginal

7. Name and address of person responsible for further information:
Nylander, Pauli
Vaisala Oy
PL 26
SF-00421 Helsinki,
Finland
Telefax: +358-0-8949227

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 2.10.3. [28]

Country: Finland

General information

1. Short identification of the instrument including the parameter measured, or its function: FD12P Present Weather classification sensor (Precipitation type & intensity, visibility, precipitation amount)

2. State of development: Several tests 1992 - 1993. release for sales 1993.
First year of operational use: 1993 (est.)

3. Principle of operation: Forward scatter signal analysis and heated capacitive surface signal data combined by the device software in real time.

4. **Main technical characteristics:**
4.1 application: SYNOP WaWa codes except cloud and thunderstorm.
4.2 measuring range: Visibility 20 -20,000 m (—50 km/ ave 10 min), precipitation type, ON/OFF accumulation, intensity, water content, snow type, fog, smoke, freezing rain.
4.3 uncertainty:
4.4 time constant: (4 min typical)
4.5 averaging time: 1 min 10 min visibility
4.6 reliability: MTBF (predicted) > 10,000 h
4.7 interface and output details: Serial line (RS 232, RS 485, V.21)
4.8 power requirements:
4.9 servicing interval:
4.10 other characteristics:

- Freezing rain reported, when rain detected and the device mechanics temperature is below zero. Smoke is reported if visibility less than 1100 m and the capacitive surface does not give signal even without heating
- Droplet size spectrum is measured internally and used to determine drizzle and snow types.
- Many analysis parameters are user selectable.

Experiences and other information

5. Experience from comparisons and tests performed: Tested in Finland from 1990 at Helsinki-Vantaa airport and Jokioinen Observatory in 1992.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Marginal

7. Name and address of person responsible for further information:

Nylander, Pauli
Vaisala Oy
PL 26
SF-00421 Helsinki,
Finland

Telefax: +358-0-8949227

8. Major bibliographic references, applicable patents, etc.:
Patent pending for the method and device (Finland, EPO, Japan, Australia)

Identification number: 2.10.4. [35]

Country: France

General information

1. Short identification of the instrument including the parameter measured, or its function: Back scattermeter VISIVIA

2. First year of operational use: 1991

3. Principle of operation: Back scatter of light emitted by a xenon flash lamp. Automatic compensation of the variations of the flash lamp by fibre optics. Modular construction, permits on site maintenance.

4. **Main technical characteristics:**

4.1 application: Measurement of the Meteorological Optical Range

4.2 measuring range: 10 - 1000 m

4.3 uncertainty:

4.4 time constant: 1 minute

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: RS 232 or analogue output, 4 - 20 mA

4.8 power requirements: 220 V AC, 50 - 60 Hz

4.9 servicing interval: 4 months

4.10 other characteristics: The transmitter is provided with a xenon flash lamp. The optical receiver is constructed with a compound lens together with un diaphragm and a PIN photodiode. The power of the light, emitted by the flash lamp is subject to variations of a pulse to another. To remedy for this, the emitted power is controlled by a optical fibre which takes a fraction of the light.
To protect against parasitic products from the lamp due to glittering, the parts of the emitter and the receiver form a Faraday cage. The amount of the back scattered light is digitized and then transmitted by command over a serial line.
To simplify the maintenance, Visivia is designed in a modular way.

Recalibration of the Visivia is possible on site with the Optical device to be placed on the instrument and which permits to simulate low visibilities.

Experiences and other information

5. Experience from comparisons and tests performed: The prototypes, adjusted by Météo France are tested for several years. The industrial version is tested since 1990 by Météo France.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: 5%

7. Name and address of person responsible for further information:

Collet, Gérard
Pulssonic
B.P. 330
F 91958 Les Ulis Cédex,
France
Telefax: (33)1 64.46.25.22

8. Major bibliographic references, applicable patents, etc.:
Patent No. 88 - 00561 dated 19/01/88, entitled: "Dispositif destiné à la détection des variations de transparence d'une atmosphère à contrôler." (Device to detect the variations of the transparency of an atmosphere to be controlled)

Identification number: 2.10.5. [39]

Country: France

General information

1. Short identification of the instrument including the parameter measured, or its function: The instrument, "Visivia", is designed to measure the visibility in the range 0 - 1000 m based on the light scattering principle.

2. State of development: Industrialization of the instrument is to be completed. Installed on a number of sites along the roadside and on meteorological sites.
First year of operational use: 1993

3. Principle of operation: The operation of the instrument is based on the light scattering principle. The transmitter is a Xenon flash lamp. The receiver is placed on the side to collect the light back scattered by the droplets.

4. **Main technical characteristics:**

4.1 application: Measurements of low visibility within the range 10 - 1000 m; Road Weather

4.2 measuring range: 10 -1000 m

4.3 uncertainty: 20%

4.4 time constant: 1 min.

4.5 averaging time:

4.6 reliability: Very good

4.7 interface and output details: RS 232 C

4.8 power requirements: Electricity grid

4.9 servicing interval: 3 months

4.10 other characteristics: The instrument has to be installed on an experimental site free from obstacles within a distance of ten meters across the transmitter/receiver case.
It must be oriented towards North to minimize influences by direct sunlight

Experiences and other information

5. Experience from comparisons and tests performed: The instrument is tested on site along the roadway and on meteorological sites as well as in mist chambers. The results are satisfactory.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Gaumet, Jean-Louis
SETIM/R.E.D.
7 rue Teisserence de Bort
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:

- Gaumet, J.L., P. Salomon: "A Visibility meter for the Highways Meteorology", 6th Symposium on Meteorological Observations and Instrumentation, (New Orleans, USA, January 1987)
- Gaumet, J.L., P. Salomon, Tran Quoc: "Un Visibilemetre pour la Sécurité Routière", Le Meteorologie 7th Series no. 25 (1988), 24 - 32

Other entries related to this category:

2.0.4
2.2.3
2.9.2
2.22.9

2.11. Cloud observation

Identification number: **2.11.1.** [127]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function: Remote sensor to measure the cloud base; russian model no. PBO-2
2. First year of operational use: 1991
3. Principle of operation: Remote sensing optical device which measures the amount of time for which a transmitted light pulse travels vertically to the cloud and backwards to the receiver
4. **Main technical characteristics:**

4.1	application:	Aeronautics
4.2	measuring range:	50 m to 2000 m
4.3	uncertainty:	According to the height of the ceiling
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	
4.8	power requirements:	220 V
4.9	servicing interval:	Yearly maintenance
4.10	other characteristics:	Long term stability, robust, reliable

Experiences and other information

5. Experience from comparisons and tests performed:
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	

7. Name and address of person responsible for further information:

Slimi, Ali
Institut National de la Meteorologie
B.P. 156
2035 Tunis-Cartage
Tunisia
Telefax: +216-1 784 608

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.11.2.** [136]

Country: **United States of America**

General information

1. Short identification of the instrument including the parameter measured, or its function: Ceilometer, model CT12K: Cloud height and vertical visibility
2. State of development:
First year of operational use: 1989 (refers to current version)
3. Principle of operation: Lidar principle, pulsed diode laser, fast digitizer & averager, comprehensive microprocessor data processing for cloud base detecting and vertical visibility calculating.
4. **Main technical characteristics:**

4.1	application:	Airport cloud height observer's and ATC aid, autonomous with recorder or part of AWS
4.2	measuring range:	0 ... 12,650 feet

4.3 uncertainty: (±20 ft or 2%) ± 25 ft (half resol.)
4.4 time constant:
4.5 averaging time: 12 s or 24 s
4.6 reliability: MTBF (realized) more than 40,000 hours
4.7 interface and output details: Digital RS-232C, V.21, Bell 103: Several messages.
Gifft RBC Recorder (facsimile)
4.8 power requirements: 100/115/220/240 V AC, 800 W
4.9 servicing interval: Window cleaning recommended every 90 days
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: WMO International Ceilometer Intercomparison (early version, see: refs.); U.S. NWS/K220 Phase II (current version)

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Marginal

7. Name and address of person responsible for further information:

Lönnqvist, Jan
Vaisala Oy, PL 26
00421 Helsinki
Finland

Telefax: +358-0-8949227

8. Major bibliographic references, applicable patents, etc.:

- Jones, D.W., Ouldridge, M., Painting, D.J. (1988): "WMO International Ceilometer Intercomparison", WMO Instruments and Methods of Observing Methods Report No. 32
- Final Report U.S. NWS/K220 Phase II

Other entries related to this category:

2.0.3
2.2.3

2.12., 2.13., 2.14.: N/A

2.15. Observation of atmospherics

-None-

Other entries related to this category:
2.9.2

2.16. Instruments and observations at aeronautical meteorological stations

Identification number: **2.16.1.** [128]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic aeronautical station, Sioma, capable to measure temperature, relative humidity, pressure, precipitation, wind and cloud base.

2. First year of operational use: 1992

3. Principle of operation:
Automatic aeronautical station composed of 3 subgroups:
1. Meteorological data acquisition system
2. Calculator of aeronautical data
3. Dissemination network

4. **Main technical characteristics:**

4.1	application:	Aeronautical meteorology
4.2	measuring range:	Temperature: —20°C - +60°C; relative humidity: 15% - 100%RH, Wind direction: Wind rose of 18, wind speed: 0.5 - 60 m/s, pressure: 800 - 1060 hPa
4.3	uncertainty:	
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	
4.7	interface and output details:	
4.8	power requirements:	220 V
4.9	servicing interval:	Regular maintenance
4.10	other characteristics:	This automatic aeronautical station is the first in Tunisia and still under test.

Experiences and other information

5. Experience from comparisons and tests performed: Tests are going on.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Slimi, Ali
Institut National de la Meteorologie
B.P. 156
2035 Tunis-Cartage
Tunisia
Telefax: +216-1 784 608

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.16.2.** [131]

Country: **Thailand**

General information

1. Short identification of the instrument including the parameter measured, or its function: AWOS (Impulsphysik GmbH), measures pressure, temperature, humidity, wind, precipitation, visibility and cloud bases.
2. First year of operational use: 1992
3. Principle of operation: Electronic equipment with processing unit and monitor display
4. **Main technical characteristics:**
4.1 application: AWOS for airport
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability: OK
4.7 interface and output details:
4.8 power requirements: 220 V AC, 50 Hz
4.9 servicing interval: Control: Every 30 min
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: To be developed the weather observation equipment for airport
6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:
7. Name and address of person responsible for further information:
Chandraramya, Varesuan
Meteorology Instrument Div.
4353 Sukumvit road
Bangkok
Thailand
Telefax:
8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.16.3.** [132]

Country: **Thailand**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Windshear alert system in AWOS (Ultrasonics Inc.), measures pressure, temperature, humidity, wind, precipitation, visibility and cloud bases.
2. First year of operational use: 1992
3. Principle of operation:
- Electronic equipment with processing unit and monitor display;
- The Low Level Wind Shear System can be added to the AWOS;
- The Wind Shear Section are typically five or six remote wind field sites and the central processing unit, including with AWOS
4. **Main technical characteristics:**
4.1 application: Wind shear detection for International Airport

4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability: OK
4.7 interface and output details:
4.8 power requirements: 220 V AC, 50 Hz
4.9 servicing interval: Control: Every 30 min.
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: To be developed the weather observation equipment for International Airport

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:

7. Name and address of person responsible for further information:

Chandraramya, Varesuan
Meteorology Instrument Div.
4353 Sukumvit road
Bangkok
Thailand
Telefax:

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:
2.22.9
2.22.10

2.17. Marine observations

Identification number: **2.17.1.** [7]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function: 3 meter discus and 6 meter boat shaped (Nomad) Moored meteorological buoys.
2. First year of operational use: 1988
3. Principle of operation: Conventional wind, temperature, humidity, pressure, wave and water temperature measurements using commercial sensors and a data acquisition and processing payload.
4. **Main technical characteristics:**

4.1 application: Marine
4.2 measuring range: Variable
4.3 uncertainty:
4.4 time constant: Instrument dependent
4.5 averaging time: Instrument dependent
4.6 reliability:
4.7 interface and output details: Goes and argos satellite communications to local user terminal where data decoded and transmitted on DOS. Hourly reports provided.
4.8 power requirements: Battery/Solar power
4.9 servicing interval: 1 to 2 years
4.10 other characteristics: For use in ice free waters

Experiences and other information

5. Experience from comparisons and tests performed: Hull designs provided by U.S. National Data Buoy Service (NDBC). Performance reports available from NDBC.
6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: Not Available

7. Name and address of person responsible for further information:
   McLauren, Ron
   AES, Vancouver,
   Canada
   Telefax: 604-664-9195
8. Major bibliographic references, applicable patents, etc.:
   Payload propriety to AXYS Ltd., telefax no. 604-655-3435

Identification number: **2.17.2.** [9]

Country: **Canada**

General information

1. Short identification of the instrument including the parameter measured, or its function: Qualimetrics Laser Ceilometer. Combined with special Atmospheric Environment hardware and software
2. First year of operational use: 1992
3. Principle of operation: Lidar measurement of cloud height combined with a time average to estimate cloud amount in up to 4 layers.
4. **Main technical characteristics:**

4.1 application:

4.2 measuring range: Surface to 3,000 m
4.3 uncertainty:
4.4 time constant: 1 minute
4.5 averaging time: 1 hour
4.6 reliability:
4.7 interface and output details: FSK ASCII - To automatic weather station which formulates cloud reports and transmits them by phone.
4.8 power requirements: 110 V AC
4.9 servicing interval: 6 months with weekly lens cleaning
4.10 other characteristics: Cloud Processing algorithm proprietary to the atmospheric environment service.

Experiences and other information

5. Experience from comparisons and tests performed: Intercomparisons with human observations. (Internal reports)

6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs: Not Available

7. Name and address of person responsible for further information:
McKay, Dave
4905 Dufferin Street
Downsview, Ontario M3H 5T4,
Canada
Telefax: 416-739-5721

8. Major bibliographic references, applicable patents, etc.:
Characteristics of the ceilometer and cloud processing algorithm have been presented at various conferences. Ceilometer is proprietary to Qualimetrics Inc. Fax: #916-928-1165

Identification number: 2.17.3. [97]

Country: Norway

General information

1. Short identification of the instrument including the parameter measured, or its function:
"TOBIS" (Telemetering Oceonographic Buoy-Integrated System): Air pressure, air temp., wind speed/dir., sea temp., salinity, oxygen, current speed/dir., light transmission, radioactivity, wave height/period., nutrients.

2. First year of operational use: ...

3. Principle of operation: The above mentioned parameters are measured in intervals according to international standards. A selected preprocessed data set is transmitted via the CLS - ARGOS system. Pre-processed and raw data are also stored on hard disk onboard the buoy.

4. **Main technical characteristics:**
4.1 application:
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details:
4.8 power requirements:
4.9 servicing interval:
4.10 other characteristics:
- The buoy was used in calibration of the ERS-1 satellite.

- Onboard storage capacity is 60 MB of data.
- Sampling rate and resolution is according to FIESTA-standards.
- The number and type of sensors can be selected by the costumer, according to the need of measurements.

Experiences and other information

5. Experience from comparisons and tests performed: The buoy is used in the Seawatch Europe programme, and in other Seawatch programmes.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Olsen, Egil
Oceanor', Pir-Senteret
7005 Trondheim,
Norway
Telefax: +47-7-525033

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.17.4.** [145]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Data buoy monitoring: Barometric pressure, wind speed and direction, maximum gust, air and sea surface temperature, humidity, wave height and period

2. First year of operational use:

3. Principle of operation: Semispar buoy moored (usually) in depths > 2 km

4. **Main technical characteristics:**

4.1 application:

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements:

4.9 servicing interval:

4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Bentley, Anthony
Meteorological Office, RM B6
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom
Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:

Paper in preparation

Other entries related to this category:
2.22.10

2.18., 2.19., 2.20.: N/A

2.21. Measurement of sunshine duration

Identification number: **2.21.1.** [18]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: SONI automatic sunshine duration sensor
2. First year of operational use: 1993
3. Principle of operation: SONI senses the levels of radiation from narrow segments of the sky with a rotating split diaphragm. The incoming light is guided by a rotating light guide to a fixed photo-cell. the photo-cell is zeroed every second revolution by a dark phase.
4. **Main technical characteristics:**

4.1	application:	Automatic sunshine duration
4.2	measuring range:	Adjustable, 120 mW/cm^2, resolution 2 sec.
4.3	uncertainty:	Threshold 3%
4.4	time constant:	
4.5	averaging time:	
4.6	reliability:	Rugged device
4.7	interface and output details:	Yes/no: Output 4.5/0 V. Data logging with printer port of handhold PC-micro computer
4.8	power requirements:	24 V AC
4.9	servicing interval:	1 year
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: National and international comparisons
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	-

7. Name and address of person responsible for further information:
   Laitinen, Leila; meteorologist
   PL 503 (Vuorikatu 24),
   00101 Helsinki,
   Finland
   Telefax: (+358 0) 179581
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.21.2.** [72]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: SONI e, sunshine duration sensor
2. First year of operational use: 1984
3. Principle of operation: The sensor, SONI, is designed to record automatically the duration of sunshine. It can be connected to an automatic weather station to meet the requirements of particular areas of application. SONI responds to the irradiance of the incidence direct solar radiation. The threshold level of the irradiance which defines sunshine can be set at any level over a wide range. the sensor does not have to

be aligned in a particular direction when being set up nor does the latitude have to be taken into account. thus the principle of measurement permits the sensor to be used on buoys too.

4. **Main technical characteristics:**

4.1 application: Measurement of sunshine duration

4.2 measuring range: Threshold: 120 W/m^2

4.3 uncertainty: ≤ 15 W/m^2

4.4 time constant: 2 sec

4.5 averaging time: resolution in time

4.6 reliability: MTBF: about 1 year

4.7 interface and output details: Sunshine: 4.5 - 5.0 V, no sunshine 0 - 0.6 V

4.8 power requirements: 24 V / 50 Hz, 6 W

4.9 servicing interval: twice per year

4.10 other characteristics:

Principal features:

- In recording the irradiance, the SONI operates in a fully rotationally symmetrical manner, scanning the complete sky hemisphere by a rotating slit. It consists essentially of a slit diaphragm, an optical waveguide and a photocell.
- The waveguide is surrounded by a slit diaphragm. These two elements are firmly connected to each other and rotate together. The light which passes through the slit in the diaphragm is guided through the optical waveguide and emerges from the latter aligned with the axis of rotation of the measuring head. At the end of the waveguide there is a photocell which converts the radiation received into electrical signals. Since the end of the waveguide is positioned concentrically above the photocell and its position relative to the latter does not change as it rotates, the photocell can be mounted in a fixed manner. This means that the electrical connections to the photocell can be stationary.
- In the plane between the waveguide and the photocell there is a rotating shutter which screens the light from the optical waveguide reaching the photocell every second revolution of the slit. The zero-point of the sensor is established during the dark phase.

Experiences and other information

5. Experience from comparisons and tests performed: See reference no. 3

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Negligible

7. Name and address of person responsible for further information:

Lindner, Peter
Deutscher Wetterdienst
Instrumentenamt Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany

Telefax: +49-40-60173102

8. Major bibliographic references, applicable patents, etc.:

1 Lindner, P. (1984): "A New Sunshine Duration Sensor", WMO/CIMO-TECEMO, Noordwijkerhout, Netherlands, 24 - 28 Sept. 1984. In: WMO Instr. and Obs. Meth. Rep. No. 15, p. 179

2 Dehne, K. (1989): "Preliminary Results of the WMO Automatic Sunshine Duration Measurement Comparison 1988/89 in Hamburg", WMO/CIMO-TECIMO IV, Brussels, Belgium, 4 - 8 September 1989. In: WMO Instr. and Obs. Meth. Rep. No. 35 (WMO/TD-No. 303), pp. 27-32

3 Dehne, K., Bergholter, U. (1991): "WMO Sunshine Duration Measurement Comparison 1988/89 in Hamburg". In: PIC VII, Working Report Nr. 162, Swiss Meteorol. Inst., Davos and Zürich, March 1991

4 Deutsches Patentamt (1983): Offenlegungsschrift DE3127086A1 v. 27.1.1983
5 Sunshine Duration Sensor SONI is produced by: Laborgerätebau, Horst Siggelkow, Eschelsweg 4, D-2000 Hamburg 50, Germany

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Identification number: **2.21.3.** [82]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Sunshine duration and solar energy sensor SONI e2

2. State of development: -
First year of operational use: 1984

3. Principle of operation: Direct measurement of the strength of solar radiation in the spectral range of 0.4 ... 1.1 µm. The output signal is linear in the specified range

4. **Main technical characteristics:**

4.1	application:	Measurement of the sunshine duration and solar energy
4.2	measuring range:	0 ... 1200 W/m^2
4.3	uncertainty:	± 7% from MR
4.4	time constant:	-
4.5	averaging time:	-
4.6	reliability:	-
4.7	interface and output details:	Sunshine: Yes/No, output 5 V / 0.5 V (threshold: 120 W/m^2); Sun energy output: 0 ... 12 V (0 ... 1200 W/m^2); RS 422 data telegram
4.8	power requirements:	Supply voltage 24 V DC, approx. 250 mA: Approx. 6 W for electronic and 3 W for heating
4.9	servicing interval:	4 years
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: The sensor was constructed by technicians from the German Meteorological Service Instrumentamt Hamburg and is the standard sensor of the German Meteorological Service

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	-

7. Name and address of person responsible for further information:
Siggelkow, Jens
Eschelweg 4
D-2000 Hamburg 50
Germany
Telefax: (+49) (0)40 - 384620

8. Major bibliographic references, applicable patents, etc.:
- Sonnenscheindauer- und Energie-Sensor SONIe2 nach Lindner/Hülsen, Patent 3127086

Other entries related to this category:
2.9.5
2.22.9

2.22. Automatic meteorological stations

Identification number: **2.22.1.** [24]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: MILOS 500 Automatic Weather station for measuring all analog and digital sensors as well as to receive data through serial interfaces from intelligent sensors or from operator's terminal

2. First year of operational use: -

3. Principle of operation:
- Fully user configurable, open architecture, software under true multitasking operating system.
- Flexibility in interfacing any sensor with analog, digital or serial output.
- Designed for very harsh environments, fully protected against lightning and ESD.

4. **Main technical characteristics:**

4.1	application:	Semi and fully automatic environmental observations
4.2	measuring range:	To measure any sensor with analog, digital or serial output
4.3	uncertainty:	N/A
4.4	time constant:	N/A
4.5	averaging time:	Each sensor configuration can be independently set in the sensor configuration menu.
4.6	reliability:	MTBF over 10,000 hours (HIL-HNDK-217F)
4.7	interface and output details:	Output reports are user configurable. the standard formats exist for WMO's SYNOP, METAR and SPECI as well as for spread sheet formats.
4.8	power requirements:	11.5 - 80 V DC, 12 - 50 V AC, less than 1 W.
4.9	servicing interval:	No regular maintenance needed.
4.10	other characteristics:	

- Can interface up to 100 sensors
- Sensor sampling rate individually set for each sensor between 100 ms to 24 hours.
- Data storage capacity up to 40 MBytes using Flash EEPROM cards
- Standard configuration has 4 serial I/O ports (support up to 10)
- Calculation freely configurable using easy word processor type programming to write new formulas and algorithms

Experiences and other information

5. Experience from comparisons and tests performed: Environmental test made against several MIL-standards

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	Only power cost, less than 1 W

7. Name and address of person responsible for further information:

Kokko, Hannu
Vaisala Oy,
PL 26
00421 Helsinki,
Finland
Telefax: +358-0-8949338

8. Major bibliographic references, applicable patents, etc.:

-

Identification number: **2.22.2.** [36]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Pulsa, automatic station

2. First year of operational use: 1992

3. Principle of operation: Automatic station with very low consumption and expandable for use on a local network

4. **Main technical characteristics:**

4.1 application: Climatology, Synoptic station, Airport station

4.2 measuring range: N/A

4.3 uncertainty: 0.1 %

4.4 time constant: N/A

4.5 averaging time: N/A

4.6 reliability: 2000 h

4.7 interface and output details: Digital output by telephone line and data storage on a memory card

4.8 power requirements: No: Power supply by solar panel

4.9 servicing interval: 2 year (except for the sensors)

4.10 other characteristics: The automatic station Pulsa contents of tight modules with very small dimensions (160×160×90 mm) connected with each other by a local network. To the basic module which receives from 5 sensors, four extension modules are added, each with 8 input lines at maximum.
Maintenance will take place on site by exchanging the suspected module. The data is transmitted by the telephone network, by satellite or stored on a memory card.

Experiences and other information

5. Experience from comparisons and tests performed: The prototypes, adjusted by Météo France, are tested for several years. The industrial version is tested since 1990 by Météo France.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: 5%

7. Name and address of person responsible for further information:

Collet, Gérard
Pulsonic
B.P. 330
F 91958 Les Ulis Cédex
France
Telefax: (33) 1 64.46.25.22

8. Major bibliographic references, applicable patents, etc.:
Patent No. 88-00561 dated 19/01/88 entitled: "Dispositif destiné à la détection des variations de transparence d'une atmosphère à contrôler." (Device to detect the variations of the transparency of an atmosphere to be controlled)

Identification number: **2.22.3.** [43]

Country: **France**

General information

1. Short identification of the instrument including the parameter measured, or its function: Digital interface for on-site, called CIBUS: digital transmission of sensor output for the benefit of standardization and reliability, supplied by Degreane.

2. State of development:
First year of operational use: 1991

3. Principle of operation: Microprogrammed interfaces for the use of 1200 baud serial lines (minimal constraints for the cables) and with a question/answer protocol.

4. **Main technical characteristics:**

4.1 application: Essentially, transmission of data from distant sensors: Telemeter (Ceilometer), transmissometer, wind.

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability: very good

4.7 interface and output details: modems, 1200 baud

4.8 power requirements: 12 V (< 20 mA)

4.9 servicing interval:

4.10 other characteristics: This CIBUS interfaces are developed with industrialist Degreane in order to take care of reliability and to be able to make use of existing cables on aeronautical sites. To have reliable transmission, it is authorized up to a distance of 5 km.

Experiences and other information

5. Experience from comparisons and tests performed: Thanks to Cibus the operational installations have become more reliable.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Lafaysse, Christian
SETIM/QMR/ND
Météo France
B.P. 202
78195 Trappes CEDEX
France
Telefax: (33) 1 30.13.60.60

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.22.4.** [55]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: FMA 186, Real time data acquisition system for up to 60 sensors, programmable sensor specification. On- and off-line mode with storage of mean values. generation of SYNOP/METAR massages, comprehensive

climatology

2. First year of operational use: 1987

3. Principle of operation:
- Outdoors: CPU Intel N80C186 (12.5 MHz), up to 12 sensor interface boards, programmable, for 4 analog and 1 digital sensors each.
- Indoors: Standard IBM compatible PC with LAMBRECHT software FMA-PC

4. **Main technical characteristics:**

4.1 application: Principal land stations, aerodromes, climatological stations

4.2 measuring range: So far programmed for temperature, humidity, wind direction, wind speed, global radiation, radiation balance, pressure, precipitation, water level

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: 220 V AC, 24 V DC

4.9 servicing interval:

4.10 other characteristics:
- storage capacity 192 kB, extendable to 1 MB
- Baud rate: Up to 9600
- Lightning protection
- Modem transmission from PC station using leased lines or teleprinter lines, telephone, radio, satellite
- quality control of raw data

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Janssen, Dr. Heino
Wilh. Lambrecht GmbH
P.O.B. 26 54
Friedländer Weg 65-67
D-3400 Göttingen
Telefax: 551-49 58 12

8. Major bibliographic references, applicable patents, etc.:
- FMA 186 Automatic Meteorological Data Acquisition System, LAMBRECHT, Göttingen 1991

Identification number: 2.22.5. [70]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic system for data receiving and distribution on airports; parameters measured: Pressure, temperature, dewpoint, wind speed/direction, RVR, visibility and ceiling

2. First year of operational use: 1992

3. Principle of operation: Modular hard- and software data acquisition with an industrial PC, presentation and operating with IBM compatible PCs

4. **Main technical characteristics:**

4.1 application: Guarantee the security of air traffic up to CAT III (ICAO, Annex 3)

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details: Input: Analog/digital/frequency; output: Digital, serial

4.8 power requirements: 220 V, 50 Hz

4.9 servicing interval: twice a year

4.10 other characteristics:

- data acquisition and presentation
- coding: METAR, SPECI
- provide Air Traffic Control with meteorological data
- data transmission: Sensors - system and system-user
- computation of secondary parameters like min./max. values, averages
- monitoring of limit values and produce SPECIs
- archive all significant data

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Lindner, Peter
Deutscher Wetterdienst
Instrumentenamt Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany

Telefax: 040-60173102

8. Major bibliographic references, applicable patents, etc.:

Manufacturer:
Impulsphysik/Hagenuk GmbH
Achter de Weiden 10
Postfach 1349
D-2000 Schenefeld
Germany

Identification number: 2.22.6. [83]

Country: Germany

General information

1. Short identification of the instrument including the parameter measured, or its function:
Logging, storing and visualisation of meteorological and physical data

2. First year of operational use: 1987

3. Principle of operation: Measuring values are collected directly in the measuring field and converted to digital data. A serial RS 422 line is used to transmit the data to a MS-DOS computer. A special easy to use software stores the data on the harddisk in files, separated for each month. The user can select different time bases and charts including frequency distribution tables for wind values, minimum and maximum diagrams, overlay of two measuring channels etc.

4. **Main technical characteristics:**

4.1 application: Logging, storing and visualisation of meteorological and physical data
4.2 measuring range: Depends on the sensors
4.3 uncertainty: Depends on the sensors
4.4 time constant: Depends on the sensors
4.5 averaging time: 6 second, 2 minutes, 10 minutes
4.6 reliability: -
4.7 interface and output details: RS 422 serial data line
4.8 power requirements: Depends on the system
4.9 servicing interval: -
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:
6.2 annual operating costs: -

7. Name and address of person responsible for further information:

Siggelkow, Jens
Eschelweg 4
D-2000 Hamburg 50
Germany
Telefax: (+49) (0)40 - 384620

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: **2.22.7.** [85]

Country: **Hong Kong**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic weather station for measuring surface wind, air temperature, humidity, rainfall, atmospheric pressure and solar radiation.

2. First year of operational use: 1991

3. Principle of operation: Analog signals from meteorological sensors at the field station are sampled, digitized and processed by a microprocessor on site. One-minute averages are calculated and transmitted over data links to a central station for operational use and archive.

4. **Main technical characteristics:**

	Wind direction	Wind speed	Temperature	Pressure	Rainfall	Solar radiation
4.1 application:						
4.2 measuring range:	0 - 360°	0 - 90°	−10 - +40°C	800 - 1100 hPa	≥ 0 mm	0 - 2000 Wm^{-2}
4.3 uncertainty:	±2°	±0.5ms^{-1}	±0.25°C	±0.02% full scale	±0.5 mm	±5 Wm^{-2}
4.4 time constant:	0.1s (at 10ms^{-1})	0.5s (at 10ms^{-1})	~45s (at moving air)	data not available	N/A	< 1 min. (for 99% response)
4.5 averaging time:	1 min.	1 min.	1 min.	N/A	1 min.	1 min.
4.6 reliability:	good	very good	excellent	very good	excellent	very good
4.7 interface and output details:	analog, 0-5 V	analog, 0-5 V	analog, 0-5 V	RS-232C	switch contact	analog, 0-5 V

4.8 power requirements: Sensors and processor: 100 W
4.9 servicing interval: 1 month
4.10 other characteristics:
Processor at field:
- Data sampling rate: 1 sec.

- Local storage: Store latest 30 1-min. reports
- Data transmission: Transmit report every minute
- Telecommunications channel: RS-232C serial interface to Public Switched Data Network
- Output format: ASCII
- Product: All output parameters are based on 1-sec. raw data
- Protection: Protection against power surges and lightning strikes
- Other derived parameters: Standard deviations of wind direction and wind speed are calculated every minute using 1-second data of the past 10 minutes

Experiences and other information

5. Experience from comparisons and tests performed: Meteorological data received from the automatic weather station compare very well with those collected on site

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Field station with sensors: Approx. US$ 450; Central station: Approx. US$ 1,200

7. Name and address of person responsible for further information:
Director of the Royal Observatory, attn.: Mr. K.H. Yeung
Royal Observatory,
Nathan Road,
Kowloon,
Hong Kong
Telefax: (+852) 721-5034

8. Major bibliographic references, applicable patents, etc.:
- Wong, M.C., Yeung, K.H., Yau, L.K.: "An automatic weather station (AWS) network in Hong Kong", WMO/CIMO-TECEMO, Noordwijkerhout, Netherlands, 24 - 28 Sept. 1984. In: WMO Instr. and Obs. Meth. Rep. No. 15
- Yeung, K.H., Ng, K.K., Yau, L.K.: "A solar-powered automatic weather station", Royal Observatory technical Note No. 75, November 1987

Identification number: **2.22.8.** [89]

Country: **Republic of Korea**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic Weather Station (AWS) for measuring surface wind, air temperature, humidity and precipitation.

2. First year of operational use: These AWSs have been installed and operational since 1988

3. Principle of operation: Analogue signals from meteorological sensors at the field station are converted to digital signals and transmitted by microprocessor via telephone line to the host computer in the headquarters of the Korea meteorological Administration.

4. **Main technical characteristics:**

4.1 application: Meteorological data collection and monitoring

4.2 measuring range: Please see 4.10 and 5

4.3 uncertainty: Please see 4.10 and 5

4.4 time constant: Please see 4.10 and 5

4.5 averaging time: Please see 4.10 and 5

4.6 reliability: Please see 4.10 and 5

4.7 interface and output details:

- Interface between field station and microprocessor at local Weather Station is made via modem/telephone line
- Outputs are displayed on console and hardcopy printer, and on monitor screen in host computer

4.8 power requirements: 110/220 V AC

4.9 servicing interval: 3 months

4.10 other characteristics:

1. Measured and output parameters:
- wind speed: instantaneous 10 minutes average, daily average and maximum value
- wind direction: 0 - 360°
- air temperature: instantaneous daily average and daily extreme value
- humidity: instantaneous daily average and minimum value
- precipitation: 0.5 mm tipping bucket
- precipitation detection: rain and snow

2. Reporting period:
- more than 10 seconds (free programmable)

Experiences and other information

5. Experience from comparisons and tests performed: Wind direction: ±2.5°; wind speed: ±0.3 m/s below 10 m/s, ±3% above 10 m/s; temperature: ±0.3°C; humidity: ±3%RH; precipitation: 0.5%

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: US$ 1,000

7. Name and address of person responsible for further information:

Cho, Young-sonn
Korea Meteorological Administration,
Equipment division
1 Songwol-dong, Chongno-gu
Seoul
Korea

Telefax: 725-3268

8. Major bibliographic references, applicable patents, etc.:
- Automatic Weather Station, Jin Yang Industrial Co. Ltd. (tel. 352-4281, fax. 0341-41-7749)

Identification number: 2.22.9. [91]

Country: Morocco

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic meteorological station, type IRMOS (SIOMA).

2. State of development:

First year of operational use: The National Direction for Meteorologie (La Direction de la Météorology Nationale) has acquired and installed an automatic station at the airport of Agadir al Massira.

3. Principle of operation: The automatic meteorological station, type IRMOS (in French: SIOMA), is developed by the Degreane Company, France. The system is based on CAOBS (Observation Computer) for data acquisition and processing. Data output is according to the CIBUS principle.

4. **Main technical characteristics:**

4.1 application: Automatic station with instruments and methods of observation used in meteorological aeronautical stations.

4.2 measuring range:

4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details:
4.8 power requirements: 220 V AC (50 Hz)
4.9 servicing interval:
4.10 other characteristics: During summer months it is observed that the data from the station are very instable and outside standards. A shield to protect against the sunshine, has been installed on the units with preliminary treatment at the end of the runway to decrease the effect of solar radiation on the compounds. But in spite of this protection, certain negative effects on the data appeared during periods with very high temperatures.

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Belhouji, Abdelaziz
Direction de la Météorology Nationale,
Centre Technique et du Materiel
Aeroport Sasa/Anfa
Casablanca 02
Morocco
Telefax: 90.85.93

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 2.22.10. [99]

Country: New Zealand

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic Weather Station Systems: AWS-3A Modem reporting, AWS-3B Satellite reporting, AWS-3C Plus, AWS-3D SHIP.

2. First year of operational use: 1989

3. Principle of operation: An operating program has been written for an automatic weather station engineered around a basic Sutron Series 9000 data acquisition unit. This produces hourly, synoptic and climate reports. These are transmitted over switched telephone lines or the GMS satellite and GTS links. At airfields it is used in conjunction with a PC to include observations from ceilometers and visibility meters. A shipboard version also obtains information from a ship's computer.

4. **Main technical characteristics:**

4.1 application: Data collecting and reporting
4.2 measuring range: N/A
4.3 uncertainty: N/A
4.4 time constant: N/A
4.5 averaging time: N/A
4.6 reliability: N/A
4.7 interface and output details: Outputs in standard WMO message formats
4.8 power requirements: 230 V AC; optional: Solar power
4.9 servicing interval: Annual servicing and calibration

4.10 other characteristics: Standard sensor suite measures wind, air and earth temperature, grass minimum temperature, R.H., pressure, rainfall and solar radiation. Software processes these to provide wide range of meteorological parameters. Further processing is provided for measurement quality control and engineering monitoring.
At aerodromes both visibility meter and ceilometer are added.
Additional weather data is added in remarks field of standard message.
Data messages are stored during communication failure. This covers 24 hours for METARs, 48 hours for SYNOPS and one month for DLYCLI. Random access to station and current data (processed) is available where land lines exist.

Experiences and other information

5. Experience from comparisons and tests performed: N/A

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: N/A

7. Name and address of person responsible for further information:

Abbott,Kenneth
Meteorological Service of New Zealand Limited
P.O. Box 722
Wellington
New Zealand

Telefax: +64 4 473 5231

8. Major bibliographic references, applicable patents, etc.:

Pannett, R.A., Hartley, B.W. (1990): "An 'Intelligent' Weather Monitoring Network", Proceedings of Institution of Professional Engineers, New Zealand Annual Conference, Wellington 1990.

Identification number: 2.22.11. [104]

Country: Poland

General information

1. Short identification of the instrument including the parameter measured, or its function:
1.: Automatic hydrologic-meteorological transmitting station ASTR PSP W8080 with operational radio-transmission of hydrological-meteorological data (wind, precipitation, water level; other meteorological parameters optional)
2.: Automatic central receiving station AST LSZ/8080

2. State of development: Short series, laboratory and field tested
First year of operational use: 1991

3. Principle of operation:
1.: 19" cassette, 8080 processor (EPROM, RAM), 34 or 342 MHz transmitter (7 data bit, 110 baud, asynchr. AFSK), sensor interfaces (up to 13). Precipitation sensor: Tipping bucket rain gage. Wind sensor: Cup anemometer (light chopper) and wind vane (Gray code disk). Water level: Impulse counter, with reversed rotational signal.
2.: 10" cassette, 8080 processor (EPROM, RAM), RS 232C, 34 or 342 MHz receiver (AFSK), Amstrad CPC 6128 + RS 232C + monitor, radiotelephone FM or teletype.

4. **Main technical characteristics:**

4.1 application: Wind, precipitation, water level measuring station for hydrological-meteorological service

4.2 measuring range: Wind: 0 - 50 m/s, water level: 0 - 999 cm

4.3 uncertainty: Wind: Wind speed: ± 0.5 m/s, precipitation: ± 0.1 mm, water level: ± 1 cm

4.4 time constant: -
4.5 averaging time: 10 min.
4.6 reliability: -
4.7 interface and output details: Wind: IF/W 863-8080, precipitation: IFO/8080, water level: MPL 10/8080
4.8 power requirements: 12 V, 60 mA (for transmitting station)
4.9 servicing interval: not available
4.10 other characteristics: Data sampling interval: 15 s, averaging interval: 10 min., data transmission interval: 3 h., local data storage: Up to 24 h.
Raw 10 min averaged data transmission, central quality control; distance up to 40 km; lightning protection

Experiences and other information

5. Experience from comparisons and tests performed: Good

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: not available

7. Name and address of person responsible for further information:
Różdżyński, Kazimierz
Sędzickiego 13
81-384 Gdynia
Poland

Telefax:

8. Major bibliographic references, applicable patents, etc.:
Memo only

Identification number: 2.22.12. [118]

Country: Spain

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic meteorological station

2. First year of operational use: 1988

3. Principle of operation: Electronic equipment based on microprocessor which automatically performs reading of parameters, storage, visual display, and data processing and transmission

4. **Main technical characteristics:**

4.1 application: Synoptic and climatological station; real-time information
4.2 measuring range: Temperature, relative humidity, precipitation, pressure, irradiation, wind, evaporation, subsoil- and surface-temperature.
4.3 uncertainty: N/A
4.4 time constant: N/A
4.5 averaging time: 10 min.
4.6 reliability: N/A
4.7 interface and output details: Weather-resistant equipment which transmits the data from the central module digitally
4.8 power requirements: 25 W; heating of the sensors, if necessary: 100 W; battery for 8 hours.
4.9 servicing interval:
4.10 other characteristics:
- Typical capacity: Up to 10 sensors (adaption for up to 32 sensors)
- Sampling rate: Every 2 sec., 10-min average
- Storage: Diskette written in MS-DOS format

- Transmission: Telephone network, radio, satellite and RS-232
- Interface technique: Digital
- Communication: Character-oriented protocol
- Output of parameters:
  · Wind direction sensor: 8-channel Gray optical encoder
  · Temperature: Pt100
  · Relative humidity: Bundle of hair
  · Pressure: Capsule of piezoresistive silicon
  · Irradiance: Pyranometer
  · Evaporation: Ceramic capsule according to Dr Czeratski's principle

Experiences and other information

5. Experience from comparisons and tests performed: N/A

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Approx. 5% of init. costs

7. Name and address of person responsible for further information:
Lambas Señas, Manuel
C/Camino de las Moreras S/N
28040 Madrid
Spain
Telefax: 341-5819846

8. Major bibliographic references, applicable patents, etc.:
-

Identification number: 2.22.13. [129]

Country: Tunisia

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic station "Miria 5" allows measurement of temperature, relative humidity and precipitation.

2. First year of operational use: 1992

3. Principle of operation: Automatic station capable for data acquisition, storage and transmission of meteorological data

4. **Main technical characteristics:**

4.1 application: Climatology

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: 220 V

4.9 servicing interval: Regular maintenance

4.10 other characteristics: This station is still under test

Experiences and other information

5. Experience from comparisons and tests performed: Under test

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Slimi, Ali
Institut National de la Meteorologie

B.P. 156
2035 Tunis-Cartage
Tunisia

Telefax: +216-1 784 608

8. Major bibliographic references, applicable patents, etc.:

Identification number: **2.22.14.** [130]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic station "Miria 16" allows measurement of temperature, relative humidity, precipitation, wind direction, wind speed and pressure.

2. State of development:
First year of operational use: 1992

3. Principle of operation: Automatic station capable for data acquisition, storage and transmission of meteorological data

4. **Main technical characteristics:**

4.1 application: Climatology

4.2 measuring range:

4.3 uncertainty:

4.4 time constant:

4.5 averaging time:

4.6 reliability:

4.7 interface and output details:

4.8 power requirements: 220 V

4.9 servicing interval: Regular maintenance

4.10 other characteristics: This station is still under test

Experiences and other information

5. Experience from comparisons and tests performed: Under test

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Slimi, Ali
Institut National de la Meteorologie
B.P. 156
2035 Tunis-Cartage
Tunisia

Telefax: +216-1 784 608

8. Major bibliographic references, applicable patents, etc.:

Identification number: **2.22.15.** [137]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automatic weather Station for use in severe icing conditions

2. First year of operational use: 1992

3. Principle of operation: Wind measurements utilize a heated orthogonal pressure tube. Temperature is measured by thermistor beads, humidity by a capacitive sensor

4. **Main technical characteristics:**

4.1	application:	Severe icing environments
4.2	measuring range:	Wind: 0 to 75 m/s; temperature: —30 to +40°C, RH: 0 to 100%
4.3	uncertainty:	Wind direction: ±10°; wind speed: ±2.5 m/s ±4%; temperature: ±1°C; RH: ±5%
4.4	time constant:	Not specified
4.5	averaging time:	Various
4.6	reliability:	Good
4.7	interface and output details:	Remote modem / telephone link
4.8	power requirements:	750 W
4.9	servicing interval:	6 months

4.10 other characteristics:
- Requires power continually
- Screen temperatures available above 0°C, flexible rods to vibrate and shed ice below 0°C.
- Extra flexible rod temperature to allow for breakage in very strong winds (may need replacing between standard servicing)

Experiences and other information

5. Experience from comparisons and tests performed: Eight years of trials experience show wind measurements can be obtained under exceptional icing conditions

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:
Hatton, David
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom
Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
- WMO Instrument and Observing Methods Report No. 24
- WMO Instrument and Observing Methods Report No. 49, P.II.4

Identification number: **2.22.16.** [143]

Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. Short identification of the instrument including the parameter measured, or its function: Samos: Dry and wet bulb temperatures, humidity, pressure, wind speed and direction, rainfall, grass/concrete/soil temperatures. Cloud and visibility to be added in 1993

2. First year of operational use: March 1990

3. Principle of operation: Sensors are interfaced to microprocessor units which capture and preprocess the data, capture extremes and totals. These data are fed to a computer for display and used to produce FM12 and FM15 messages. An observer may add or amend the automatic data

4. **Main technical characteristics:**

4.1 application: Manual, automatic synoptic and climatological observing

4.2 measuring range: (see 4.10)

4.3 uncertainty: (see 4.10)

4.4 time constant:

4.5 averaging time: Wind: 2, 10 and 60 minutes, others: 1 minute

4.6 reliability: Very reliable, MTBF > 20,000 hrs

4.7 interface and output details: Interfaces are available for many standard UK Met O sensors. Flexible transmission capabilities; secondary data available for real-time use (*eg.* graphic displays)

4.8 power requirements: 230 V AC at 50 Hz

4.9 servicing interval: Annually (except humidity sensor: changed 6 monthly)

4.10 other characteristics:

Element	Resolution	Accuracy	Range
Wind speed	1 kn	±1 kn (<20 kn) ±5% (±20 kn)	0 - 150 kn
Wind direction	1 deg	±5 deg	1 - 360 deg
Air temps	0.1°C	±0.2°C	—30 - +40°C
Soil temps	0.1°C	±0.2°C	—30 - +40°C
Humidity	1 %RH	±2 %RH	20 - 100 %RH
Pressure	0.1 hPa	±0.3 hPa	900 - 1050 hPa
Rainfall	0.2 mm	The greater of 0.2 mm / ± 3%	0 - 999.8 mm
Cloud base			25 - >20,000 ft
Visibility			1 - >10,000 m

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: Not available

7. Name and address of person responsible for further information:

Wright, Alan
Meteorological Office, Met O(OI)1a,
Beaufort Park, Easthampstead
Wokingham, Berkshire RG11 3DN
United Kingdom

Telefax: (0)344 855897

8. Major bibliographic references, applicable patents, etc.:
-

_____

Other entries related to this category:
2.2.2
2.3.1
2.6.3
2.7.4
2.7.6
2.9.5
2.9.6
2.17.1
2.17.2
2.17.3

2.23. Soil moisture measurements

Identification number: **2.23.1.** [126]

Country: **Tunisia**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Neutron sensor: Measures soil humidity based on deceleration of neutrons by the sensor. Model DR 503, brand: CPN
2. First year of operational use: 1987
3. Principle of operation: The method is based on the principle of deceleration of neutrons in the soil by a sensor with fast neutrons
4. **Main technical characteristics:**
4.1 application: Agrometeorology
4.2 measuring range:
4.3 uncertainty:
4.4 time constant:
4.5 averaging time:
4.6 reliability:
4.7 interface and output details:
4.8 power requirements: 8 rechargeable batteries, each with 0.5 A
4.9 servicing interval:
4.10 other characteristics:

Experiences and other information

5. Experience from comparisons and tests performed: The use of the instrument requires precautions (because of the radio active source)
6. **Costs:**
6.1 unit cost at factory:
6.2 annual operating costs:
7. Name and address of person responsible for further information:
   Slimi, Ali
   Institut National de la Meteorologie
   B.P. 156
   2035 Tunis-Cartage
   Tunisia
   Telefax: +216-1 784 608
8. Major bibliographic references, applicable patents, etc.:
   -

2.24. Measurement of atmospheric composition, toxic chemicals and radioactive substances

Identification number: **2.24.1.** [45]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Automatic wet-chemical ozone meter with improved flow control
2. First year of operational use: 1992
3. Principle of operation: KJ reaction on coulometric measurement. Absolute method, no calibration required. Flow control by improved pumping system and mass flow meter.
4. **Main technical characteristics:**

4.1	application:	Surface ozone concentration, both on land and on ships.
4.2	measuring range:	0 -450 ppb
4.3	uncertainty:	2ppb
4.4	time constant:	1 min
4.5	averaging time:	1 min
4.6	reliability:	absolute method
4.7	interface and output details:	0 - 20 mA
4.8	power requirements:	220 V
4.9	servicing interval:	1 month - 1 year, depending on air pollution
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed: SO_2 concentration above 10 $\mu g/m^3$ must be removed by Cr_2O_3 chemical filter
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	US$ 200

7. Name and address of person responsible for further information:
   Winkler, Peter
   Deutscher Wetterdienst
   Meteorologisches Observatorium Hamburg
   Frahmredder 95
   D-2000 Hamburg 65
   Germany
   Telefax: +49 40 60173-299
8. Major bibliographic references, applicable patents, etc.:
   -

Identification number: **2.24.2.** [46]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
   Computer-controlled NO_x monitor with improved reaction chamber
2. First year of operational use: 1988
3. Principle of operation: Chemiluminescence techniques for NO detection. NO_x by Mo-converter at 350°C. New reaction chamber. Flow control by mass flow meter. Computer-controlled operation and digital signal processing.

4. **Main technical characteristics:**

4.1	application:	Surface NO_x concentration
4.2	measuring range:	0.2 ppb - 2000 ppb
4.3	uncertainty:	5%
4.4	time constant:	≤ 1 min, depending on concentration level
4.5	averaging time:	adjustable, typically 2 min
4.6	reliability:	high
4.7	interface and output details:	RS 232 and analogue output.
4.8	power requirements:	220 V
4.9	servicing interval:	1 month
4.10	other characteristics:	

Experiences and other information

5. Experience from comparisons and tests performed:

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs:

7. Name and address of person responsible for further information:

Winkler, Peter
Deutscher Wetterdienst
Meteorologisches Observatorium Hamburg
Frahmredder 95
D-2000 Hamburg 65
Germany
Telefax: +49 40 60173-299

8. Major bibliographic references, applicable patents, etc.:
-

Other entries related to this category:

2.0.2
2.0.3
2.0.4
2.17.3

2.0. Other

Identification number: **2.0.1** [22]

Country: **Finland**

General information

1. Short identification of the instrument including the parameter measured, or its function: DRS 12 Surface state sensor. Road and runway state classification (dry, wet, snow, ice, etc.).
2. First year of operational use: 1988
3. Principle of operation: Conductance and capacitance measurement combined with ground temperature sensors at two depths.
4. **Main technical characteristics:**

4.1	application:	Road and runway state monitoring
4.2	measuring range:	Meteorological conditions on road or runway
4.3	uncertainty:	N/A
4.4	time constant:	15 min for surface temperature
4.5	averaging time:	3 min for surface state analysis
4.6	reliability:	N/A
4.7	interface and output details:	DRO21 and Milos 200 Weather Station
4.8	power requirements:	3.5 W minimum
4.9	servicing interval:	Annually

4.10 other characteristics:
- Classifies the road or runway surface state: Dry, moist, wet, wet and salty or chemical frosty, snowy, icy, or drying salty surface.
- Sets a prewarning level: Ice warning, ice alarm, frost warning, or rain warning.

Experiences and other information

5. Experience from comparisons and tests performed: VTT Report TEL 0248/90, FAA Certification
6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	(communication costs depend solely on polling frequency)

7. Name and address of person responsible for further information:
Haavasoja, Taisto
Vaisala Oy,
PL 26
SF-00421 Helsinki,
Finland
Telefax:
8. Major bibliographic references, applicable patents, etc.:
Patents: USA 904710, UK 8621286, FR 8612552, Finland 853444

Identification number: **2.0.2** [57]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Tropospheric ozone lidar
2. State of development: Operational
First year of operational use: 1991
3. Principle of operation: Differential-absorbtion lidar with wavelength pair

277 nm / 313 nm

4. **Main technical characteristics:**

4.1	application:	Measurements of vertical ozone density distribution
4.2	measuring range:	0.1 to 10 km
4.3	uncertainty:	about $\pm 7.5 \times 10^{16}$ m^{-3}
4.4	time constant:	N/A
4.5	averaging time:	less than 4 min
4.6	reliability:	high; only one minor laser repair so far
4.7	interface and output details:	PC-controlled data acquisition with transient digitizers and photon counters
4.8	power requirements:	< 5 kW during measurement
4.9	servicing interval:	one year
4.10	other characteristics:	No calibration required; small uncertainty caused by changing aerosol scattering wavelength dependences

Experiences and other information

5. Experience from comparisons and tests performed: Reliable performance

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	< US$ 10,000 + 1 scientist

7. Name and address of person responsible for further information:

Trickl, Dr. Thomas
Fraunhofer-Institut für atmosphärische Umweltforschung
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany
Telefax: +49-8821-73573

8. Major bibliographic references, applicable patents, etc.:

- Carnuth, W.: "Development of a mobile differential absorbtion lidar system for tropospheric ozone measurements from near ground level up to 13 km altitude", Workshop on Tropospheric Ozone, Göttingen, Aug. 4 to 8, 1988, Book of Abstracts p. 22
- Carnuth, W., Kempfer, U., Lotz, R., Trickl, T.: "Development and Application of a Tropospheric Ozone Lidar", Transport and Transformation of Pollutants in the Atmosphere, Proceedings of EUROTRAC Symposium 1990, Garmisch-Partenkirchen, April 2 to 5, 1990, P. Borrel, P.M. Borrel and W. Seiler, Editors, p. 445-447
- Carnuth, W., Kempfer, U., Lotz, R.: "Lidar Measurements of Tropospheric Ozone", Fifteenth International Laser Radar Conference, Tomsk (U.S.S.R.), July 23 to 27, 1990, Book of Abstracts p. 202-205
- Carnuth, W., Kempfer, U., Lotz, R., Trickl, T.: "Ein troposphärisches Ozonlidar", Laser in der Umweltmeßtechnik / Laser in remote sensing, Vorträge des 10. Internationalen Kongresses Laser 91, (München, 10. bis 12 Juni 1991), Herausgeber: C. Werner, V. Klein, K. Weber, Springer (1992), p.89-92
- Carnuth, W., Kempfer, U., Lotz, R., Trickl, T.: "Tropospheric-ozone Measurements with a UV Lidar System", O.S.A. Topical Meeting on "Optical Remote Sensing of the Atmosphere", Williamsburg (Virginia, U.S.A.). Nov. 18-21, 1991, O.S.A. 1991 Technical Digest Series Vol. 18, p. 230-231

Identification number: **2.0.3** [59]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function: Lidar for the investigation of cirrus clouds, stratospheric aerosols, and temperature (30 - 80 km).

2. State of development: Partly operational, fully operational end of 1993
First year of operational use: 1992

3. Principle of operation: Backscatter lidar (light detection and ranging) for measurements of atmospheric particulate and molecular backscattering
Emitter: Pulsed Nd:YAG laser, 1064 nm, 532 nm, 355 nm
Receiver: 52 cm diameter telescope, photomultiplier (3), IR detector, transient recorder, photon counter, PC

4. **Main technical characteristics:**

4.1	application:	Profiles of cirrus clouds, contrails, stratospheric aerosols, and stratospheric and mesospheric temperature
4.2	measuring range:	3 to 80 km
4.3	uncertainty:	Depending on task, distance and signal level
4.4	time constant:	N/A
4.5	averaging time:	Depending on task, seconds to 1 hour
4.6	reliability:	High; system was designed for use under extreme climatic conditions
4.7	interface and output details:	System is PC controlled, output of transient recorder and photon counter on disk
4.8	power requirements:	220 V / 60/30/30 amp
4.9	servicing interval:	in the order of one year
4.10	other characteristics:	The lidar system is mounted on a 2-axis scanning stand for cloud investigations. The maximum height resolution is 3 m (transient recorder) and 30 m (photon counter). typical resolution is 7.5 m in cirrus clouds, 75 m in the stratospheric aerosol layer, and will be 500 m for stratospheric temperature measurements. This type of lidar requires actual radiosonde data of pressure and temperature for calibration, otherwise a standard atmosphere has to be used, resulting in calibration uncertainties. The atmosphere between Lidar and target has to be free of clouds, since the laser penetration into dense clouds is limited. Measurements of stratospheric aerosols and temperature have to be made during night-time. the lidar system is housed in a standard size container. It is transportable by truck, railway and ship. the only requirement for use is a power supply of 220 V / 60/60/30 amp.

Experiences and other information

5. Experience from comparisons and tests performed: Investigations of the stratospheric aerosol layer and intercomparisons on an international basis show that our measurements are highly reliable. They contribute to the Network of the Detection of Stratospheric Change (NDSC) through the ESMOS (European Stratospheric Monitoring Stations) programme.

6. **Costs:**

6.1	unit cost at factory:	
6.2	annual operating costs:	US$ 10,000 + 1 technician

7. Name and address of person responsible for further information:
Jäger, Dr. Horst
Fraunhofer-Institut für Atmosphärische Umweltforschung
Kreuzeckbahnstr. 19
D-8100 Garmisch-Partenkirchen
Fed. Rep. of Germany

Telefax: +49-8821-73573

8. Major bibliographic references, applicable patents, etc.:
- Jäger, H. and Hofmann, D.: "Midlattitude lidar backscatter to mass, area, and extinction conversion model based on in situ aerosol measurements from 1980 to 1987", Appl. Opt. 30(1991)127-138
- Jäger, H.: "Stratospheric Aerosols: Observations, trends, and effects", J. Aerosol Sci. 22 (1991), Suppl. 1, pp. 517-520
- Jäger, H.: "Lidar observed trend in stratospheric background aerosol", in: Technical Digest on Optical Remote Sensing of the Atmosphere, 1991 (Optical Society of America, Washington, D.C.), Vol. 18 (1991), pp. 153-155
- Jäger, H.: "The Pinatubo eruption cloud observed by lidar at Garmisch-Partenkirchen", Geophys. res. Lett. 19 (1992) 191-194

Identification number: **2.0.4** [64]

Country: **Germany**

General information

1. Short identification of the instrument including the parameter measured, or its function:
Integrating aerosol photometer for complete data sets of optical parameters of dried atmospheric particles (extinction and absorbtion coefficients, single scattering albedo, phase function, complex refractive index), soot content of particles, and visibility (by calculation from the extinction coefficient).

2. First year of operational use: -

3. Principle of operation: Measurement of scattered and transmitted radiation between 0° and 160° of scattering angle emerging from the unloaded and the particle loaded filter. Calculation of the optical parameters and the soot content of the dried particles by a discrete inversion technique. Thereafter calculation of refractive index and soot content by a model.

4. **Main technical characteristics:**

4.1	application:	Radiative transfer within the boundary layer
4.2	measuring range:	Unlimited since sampling is adjusted to atmospheric loading by particles.
4.3	uncertainty:	1 - 25 percent depending on the property
4.4	time constant:	-
4.5	averaging time:	1 - 100 hours depending on atmospheric particle concentration
4.6	reliability:	Experimentally tested by comparison with other observations
4.7	interface and output details:	No automatic output
4.8	power requirements:	1000 W h
4.9	servicing interval:	Several months
4.10	other characteristics:	The particles are sampled outside at any place with power supply. Measurements are taken in the laboratory. Per day about 5 measurements (unloaded and loaded filter) can be taken. Evaluation of results takes about 10 minutes using a fast personal computer. Linearity of detector has been checked. No absolute calibration of the detector is necessary since the scattered and transmitted radiation is normalized by the incident radiation being measured each time. Short term and long term fluctuations of the lamp are measured and considered by error calculations for each measurement.

Experiences and other information

5. Experience from comparisons and tests performed: Extinction and absorbtion

coefficients, refractive indices, and soot content of the particles have been tested directly by comparison with other methods. For all the other properties there exist no direct tests.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: About US$ 5,000

7. Name and address of person responsible for further information:

Hänel, Prof. dr. Gottfried,
Institute of Meteorology and Geophysics
Feldbergstraße 47
D-6000 Frankfurt/Main
Fed. Rep. of Germany

Telefax: +49-69-7983280

8. Major bibliographic references, applicable patents, etc.:

- Hänel, G. (1987), Contrib. Atmos. Phys. 60, 241-247
- Hänel, G. (1988), Appl. Optics 27, 2287-2295
- Hänel, G., and Hillenbrand, Ch. (1989), Appl. Optics 28, 510-516
- Hänel, G. (1993), publication in preparation

Identification number: 2.0.5 [98]

Country: New Zealand

General information

1. Short identification of the instrument including the parameter measured, or its function:
Automated Sensor Calibration System

2. First year of operational use: 1991

3. Principle of operation: A MacIntosh computer with software written in "Hypertalk" controls the sensor calibration environment and measurement standard instruments over an IEC 625 interface bus.

4. **Main technical characteristics:**

4.1 application: Calibration of pressure, temperature, humidity and solar radiation sensors

4.2 measuring range: Normal atmospheric operating ranges

4.3 uncertainty: One order better than sensors under calibration. highly reproducible routines

4.4 time constant: related to sensor time constants

4.5 averaging time: Related to sensor time constants

4.6 reliability: No system faults over one year

4.7 interface and output details: MacIntosh computer with HyperCard graphical user interface in IEC 625; General Purpose Interface Bus (GP-IB).

4.8 power requirements: Reliable mains power supply

4.9 servicing interval: Periodic calibration of standard instruments

4.10 other characteristics: This development relates mostly to the software system. it may be adapted for use with other calibration equipment operating on the IEC 625 Bus. Refer to 8.

Experiences and other information

5. Experience from comparisons and tests performed: Calibration officer response to system is very positive. The system saves much staff time over manual operation formerly.

6. **Costs:**

6.1 unit cost at factory:

6.2 annual operating costs: < US$ 200

7. Name and address of person responsible for further information:

Pannett, Raplh A.

Meteorological Service of New Zealand Limited
P.O. Box 722
Wellington
New Zealand
Telefax: +64 4 473 5231

8. Major bibliographic references, applicable patents, etc.:

Pannett, R., Paris, S., Burman, J. (1992): "Meteorological Sensor Calibration with 'HyperCard'", WMO/CIMO- TECO-92, Vienna, Austria, 11-15 May 1992, WMO Instr. and Observ. Meth. Rep. No. 49 (WMO/TD-No.462), pp.

Other entries related to this category:

2.7.6
2.9.2

Appendix A: Questionnaire

In this Appendix the complete letter concerning the Questionnaire on Instrument Development is presented and complete with annexes, etc.

ORGANISATION MÉTÉOROLOGIQUE MONDIALE **WORLD METEOROLOGICAL ORGANIZATION**

Téléphone: National (022) 730 81 11
Internationall + 41 (0) 22 730 81 11
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Télex: 41 41 99 OMM CH
Facsimilé: 41 22 734 23 26

SECRÉTARIAT
GENÈVE - Suisse

41, Giuseppe-Motta
Case postale No. 2300
CH-1211 Genève 2

No. W/IO/Q-INS GENEVA, 11 November 1992

Annexes: 3

Subject: Questionnaire on Instrument Development

Action required: The attached questionnaire to be completed and to be sent to the CIMO Rapporteur on Instrument Development as soon as possible but not later than 31 December 1992

Dear Sir/Madam,

The provision of high quality and compatible observational data are the fundamental basis for operational and research programmes of the World Meteorological Organization. Therefore, the increased use of new technology for effective and economical acquisition of data and in particular for the automation of observations is considered to be of great importance. This importance was one of the reasons for the Eleventh Congress of WMO to adopt Resolution 4 (Cg-XI) on the Instruments and Methods of Observation Programme (IMOP). The resolution urges, inter alia, the Members to continue and, if possible, to increase their activities for the development of new observing systems and for the improvement of sensors/instruments, including sensors for monitoring of the atmospheric composition. In particular, Project 16.3 (New developments and automation) of the WMO Third Long-term Plan (TLTP), published in WMO-No. 761, Part II, Volume 1, includes the specific task to prepare guidance material on new instruments and methods of observation to facilitate their selection and introduction into operational use by Members.

WMO and, in particular, its Commission for Instruments and Methods of Observation (CIMO), have been dealing with publications on new developments in instrumentation and observational techniques for a long period of time. Since 1968 four editions of a publication, entitled "Instruments Development Inquiry", were published. The last edition. issued in 1987 and published as Instruments and Observing Methods report No. 24 (WMO/TD-No. 231) contains information on 120 items provided by 22 Members. In order to keep the technology transfer among Members up to date, the attached updated Questionnaire

To Permanent Representatives (or Directors of Meteorological or Hydrometeorological Services) of Members of WMO (PR-48011

cc: President and vice-president of CIMO (for information)

on Instrument Development was prepared. The intention is to compile the fifth edition of the Instruments Development Inquiry on the basis of the analysis of your responses. It is planned to publish and distribute the results of this analysis before the next session of CIMO.

The preparation of this updated publication is one of the terms of reference of Dr. J.P. van der Meulen (Netherlands) who was appointed by CIMO-X as Rapporteur on Instrument Development

You are kindly invited to send the completed questionnaire at your earliest convenience but not later than 31 December 1992 directly to:

Dr. J.P. van der Meulen
Royal Netherlands Meteorological Institute
Instrument Division
Postbus 201
3730 AE De bilt
Netherlands

and at least a copy of the covering letter to:

World Meteorological Organization
World Weather Watch Department
P.O. Box 2300
Switzerland
CH-1211 GENEVA

Since instrument development is also an important objective of agencies and institutes outside of the Meteorological Service and also of manufacturers of meteorological instruments, you are kindly requested to copy and further distribute this questionnaire to them with the request to send it completed directly to the above address(es).

Instructions to assist your expert in the correct completion of this questionnaire are attached as Annex II. If instruments developed in your Service are included in the previous edition of the Instrument Development Inquiry you are also kindly requested to give information as to which of your instruments, mentioned there, have actually been put into operation and what experience has been obtained as a result of their operational application. Further, it would be highly appreciated to receive additional information on results of comparisons of these instruments against reference instruments or standards which have been carried out in your Service.

Yours faithfully,

(G.O.P. Obasi)
secretary-General

Instruments Development Inquiry
-Fifth Edition-

Q U E S T I O N N A I R E
on Instrument Development

Please read the instructions in Annex II before completing this questionnaire
[notes in the form refer to the numbered instructions]

Country:	**No.:** (Running number of the completed questionnaires)

A. Classification

I. Tick one of the appropriate boxes:

1 Instrument under development.....	
2 Instrument put in operational use in recent 4 years.....	

II. Category number(s) selected from "List of Categories"(see Annex I)
At least one number should be entered [7, 9]

III. Background information on the reasons of the development:
At least one box should be ticked.

1 Cost effectiveness (initial or operational)	
2 Automation of manual observation	
3 New type of observation	
4 Improved reliability or accuracy	
5 Less maintenance	
6 Other (please specify):	

B. Questions to be answered (if applicable)

General information request

1. Short identification of the instrument including the variable measured, or its function [10]:

2. a) For instruments under development only:
State of development:

.....

b) For instruments put into operational use only:
First year of operational use:

.....

3. Principle of operation; specify in short terms the basic technology:

.....

.....

.....

.....

4. Main technical characteristics [8]

4.1 Application:

4.2 Measuring range: .....

4.3 Uncertainty: .....

4.4 Time constant: .....

4.5 Averaging time: .....

4.6 Reliability: .....

4.7 Interface and
output details: .....

4.8 Power requirements: .....

4.9 Servicing interval: .....

4.10. Other characteristics [11]:

Experiences and other information

5. Experience from comparisons and tests performed: [especially important for instruments put into operational use]

.....

.....

6. Costs, preferably in US$. For instruments under development, please enter estimated costs.

6.1 Unit cost at factory:

6.2. Annual operating costs:

7. Name and address of the expert responsible for further information:

Name: .....First name: .....

Address: .....

.....

Telefax: .....

8. Major bibliographic references, applicable patents, etc.

Place: ..... Date: ..... Signature .....

Instruments Development Inquiry
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L I S T o f C A T E G O R I E S
concerning the Questionnaire on Instrument Development

1. General (pertaining to general requirements of meteorological stations)
2. Weather observations (techniques of observation)
3. Measurement of atmospheric pressure
4. Measurement of temperature
5. Measurement of humidity
6. Measurement of surface wind
7. Measurement of precipitation
8. Measurement of evaporation
9. Measurement of radiation
10. Measurement of visibility
11. Cloud observation
12. (not applicable: Measurement of upper wind)
13. (not applicable: Radiosonde techniques)
14. (not applicable: Meteorological balloon techniques)
15. Observation of atmospherics
16. Instruments and observations at aeronautical meteorological stations
17. Marine observations
18. (not applicable: Meteorological observations from aircraft)
19. (not applicable: Meteorological rocket sensing)
20. (not applicable: Lower tropospheric sounding)
21. Measurement of sunshine duration
22. Automatic meteorological stations
23. Soil moisture measurements
24. Measurement of atmospheric composition, toxic chemicals and radioactive substances.

0. Other

Instruments Development Inquiry
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I N S T R U C T I O N S
to complete the Questionnaire on Instrument Development

General instructions

1. For each item of instrument development a separate questionnaire should be filled in. Please reproduce additional blank questionnaires by photocopy.

2. Use a typewriter or a printer. In case of processing by a computer the structure and format of the printed output should be similar.

3. The amount of information provided should be restricted to the space as reserved for each question. Please do not send additional information sheets (documents, pictures, drawings, circuit diagrams, etc.). No provision is being made to reproduce them.

4. If not applicable, questions may left open. Please indicate:. **not applicable**

5. Send completed questionnaire(s) to:

Dr.Jitze P. van der Meulen, Royal Netherlands Meteorological Institute -Instrumentation division- Postbus 201 3730 AE De Bilt, Netherlands.

Please indicate reference and subject.

In case of doubt or questions you may contact Dr.Jitze P. van der Meulen directly via:

Tel.:(+31)30-206432
Fax.:(+31)30-210407
E-mail:vdmeulen@knmi.nl

6. You are requested to send, at least a copy of the covering letter of the completed questionnaire, to:

WORLD METEOROLOGICAL ORGANIZATION -World Weather Watch Department- P.O. Box 2300 CH - 1211 Genève 2 Switzerland

Specific instructions

7. Only instruments concerning surface measurements are applicable.

8. Please consult the WMO Guide to Meteorological Instruments and Methods of Observation (WMO No.8), Fifth edition (1983) for consistent use of classification or characterization. (in particular question 5)

9. In the space marked "Category number(s).. ", enter the appropriate number from the "List of Categories" (Annex I). If the item of instrument development fits into two or more category numbers fill in all these numbers. If no specific category can be selected enter zero ("Other").

10. Question 1 ("Identification of the instrument"): Enter name of device and model number (if applicable) and parameter(s) measured.

11. Question 4.10 ("Other characteristics"): Please enter the information you consider to be of consequence for the particular type of instrument. Examples of items which could be added are: Stability of calibration characteristics, durability (weather conditions), specificity of response (sensitivity to other variables), exposure requirements (radiation shield for temperature measurements), linearity of response, maintenance requirements, lightning and other protection, working autonomy.

    For Automatic Meteorological Stations (Category No. 22) more specific characteristics are of special interest: Data acquisition capacity, station sampling rate, local storage and data transmission, technique of interfacing and communication aspects, output format, summary of processing possibilities (quality control; raw signal/data conversion; production of significant meteorological parameters), environmental conditions and protection, general characteristics of sensors.

    In case the instrument is classified as "Other Category" this space may be used to enter appropriate and specific instruments characteristics.