WORLD METEOROLOGICAL ORGANIZATION

INSTRUMENTS AND OBSERVING METHODS

REPORT No. 71

Instrument Development Inquiry

(Sixth Edition)

by

J.P. van der Meulen

Netherlands

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NOTE

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FOREWORD

The provision of compatible measurements of high quality is fundamental for the operational and research programmes of Members 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 Twelfth Congress of WMO urged that Members 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. This is often now done in close collaboration with instrument manufacturers and designers in the private sector.

WMO, and particularly the Commission for Instruments and Methods of Observation (CIMO), has for a long time been publishing information 0fl new developments in instrumentation and data acquisition systems. Since 1968 five editions of publication with the title of *"Instruments Development lnquiry"* have been published. This, the sixth edition of the *Instrument Development Inquiry, contains* the information from 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 27 Members in 208 completed questionnaires. This demonstrates a significantly growing interest and participation compared with the fifth edition.

The information in this publication will assist Members 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 d& Meulen, the CIMO Rapporteur on Instrument Development, who has again 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 sixth edition of the Instrument Development Inquiry. The CIMO Working Group on Surface Measurements had decided to circulate to all W.M.O. Members a new questionnaire on instrument development. This inquiry is in line with resolution 4 (Cg-XII) and CIMO-XI recommendations. A total number **208** completed questionnaires from 27 countries were returned. Responses from 15 countries informing that no developments were carried out were recieved as well. In this questionnaire a choice could be made between:

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

The questionnaire also asked to indicate the category-of-measurement number to which the (to be) developed instrument belongs. Twenty-three possibilities were put on the List of Categories (like Measurement of atmospheric pressure, or temperature, etc.). This list is based on the newest, sixth version of the Guide to Meteorological Instruments and Methods of Observation (WMO No. 8), but it was decided to exclude ten types of measurements or techniques. The reason for this was to eliminate overlap with other work by WMO on this matter. The categories which were left outside the scope of the questionnaire are:

1.16 Measurement of Ozone
1.17 Measurement of atmospheric composition, toxic chemicals and radioactive substances.
2.8 Satellite observations
2.9 Radar measurements
2.10 Balloon techniques
3.1 Sampling meteorological variables
3.2 Data reduction
3.3 Quality management
3.4 Training of instrument specialists
3.5 Testing, calibration and intercomparisons

Nevertheless, a category,

3. Other

was included for al other possible technologies, which may be outside the scoope of the CIMO guide.

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: 208 replies for this edition implies an increase of 45% with respect to the previous edition of the Instrument Development Inquiry (Fifth Edition, Instruments and Observing Methods Report No. 54, 1993, WMO/TD - No. 578). 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 itself is attached to this report as an appendix.

1. Introduction

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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 Fourth WMO Long-Term Plan (FLTP), concerns itself with a number of specific objectives on this matter. This importance was one of the reasons for the Twelth World Meteorological Congress to adopt resolution 4 (Cg-XII) on the IMOP. In particular, project 16.1 of the FLTP, published in WMO-No. 830, Part II, Volume 1, includes the specific tasks in line with the main long-term objectives of the IMOP. It is stated in the FLTP 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.

In line of these objectives CIMO-XI appointed a Rapporteur (the author of this report), to serve within the Working Group on Surface Measurements as a focal point on the matter of Instrument Development. Based on the positive experiences of the previous inquiries the Working Group decided to organize a new inquiry.

2. Organization

In July 1997 a request to complete the questionnaire was distributed to all W.M.O. Members to be returned before 15 August 1997 (see Appendix A for a copy of this questionnaire). Most of the replies were received by the rapporteur before September 1997, but the latest reply was received in Februari 1998. Therefore the state-of-development for all instruments under development, indicated in the questionnaire may be dated as 1 September 1997.

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 23 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, Telephone, Telefax, e_mail address, URL or Internet WEB site)
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:

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Royal Netherlands Meteorological Institute
Operational Observations,
Postbus 201
3730 AE De Bilt, Netherlands.
tel.: +31 30 2206432
fax : +31 30 2210407
e-mail: meulenvd@knmi.nl (internet)

The most convenient format will be in WordPerfect 5.1 "Mailmerge secondary source" on a MS-DOS formatted diskette (or via e_mail), 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 **27** 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**
Australia	5
Canada	10
China	18
Finland	29
Germany	6
Hong Kong, China	1
Japan	10
Kuwait	1
Lithuania	1
Mexico	2
The Netherlands	12
Norway	1
Pakistan	1
Philippines	1

State / Territory	number
Poland	2
Portugal	8
Russian Federation	7
Singapore	4
Slovakia	1
South Africa	4
Sweden	3
Switzerland	1
Thailand	4
Ukraine	1
United Kingdom of Great Britain and Northern Ireland	4
United States of America	65
Uzbekistan	6

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 new, sixth edition of CIMO-Guide (WMO No. 8). The following categories were possible:

1. Measurement of Meteorological Variables

1.1 General
1.2 Measurement of temperature
1.3 Measurement of atmospheric pressure
1.4 Measurement of humidity
1.5 Measurement of surface wind
1.6 Measurement of precipitation
1.7 Measurement of radiation
1.8 Measurement of sunshine duration
1.9 Measurement of visibility
1.10 Measurement of evaporation
1.11 Measurement of soil moisture
1.12 Measurement of upper air pressure, temperature, humidity
1.13 Measurement of upper wind
1.14 Measurement of present and past weather, state of the ground
1.15 Observation of clouds

2. Observing Systems

2.1 Measurement at automatic meteorological stations
2.2 Instruments and observations at aeronautical stations
2.3 Aircraft observations
2.4 Marine observations
2.5 Special profiling techniques for the boundary layer and the troposphere
2.6 Rocket measurements in the stratosphere and mesosphere
2.7 Locating the sources of atmospherics

3.0 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: 1.16 Measurement of Ozone, 1.17 Measurement of atmospheric composition, toxic chemicals and radioactive substances, 2.8 Satellite observations, 2.9 Radar measurements and 2.10 Balloon techniques. 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). All these items can be found under category 3, *Other*.

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
(6) Improved quality control
(7) Data reduction

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 27 Members a total amount of 208 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 208 entries can be divided over two types of classes: "Under development" and "Operational":

(1) Instrument under development 67
(2) Instrument put in operational use in recent 4 years 141

For a number of 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. On the other hand, for some entries 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 much larger the instruments under development (68% versus 32%).

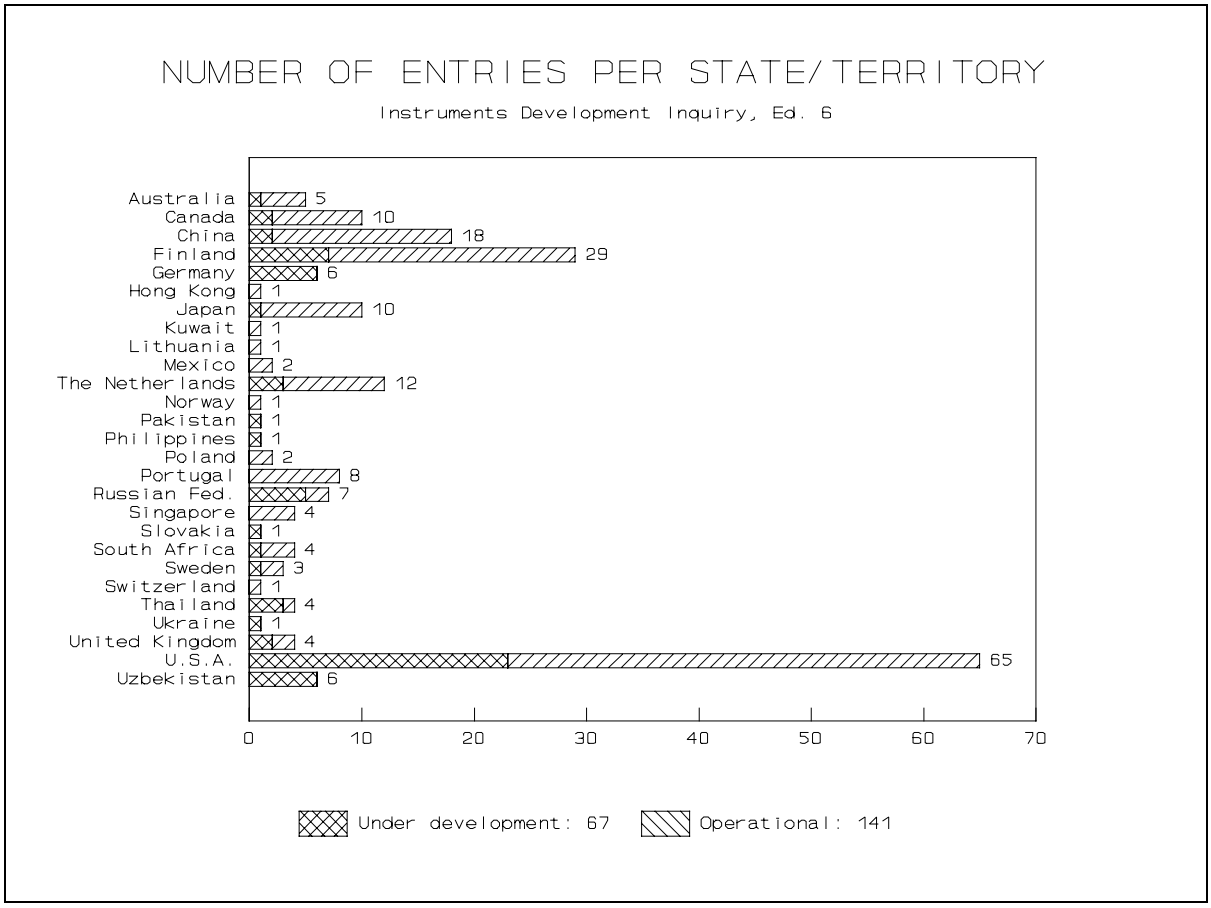

Fig. 1 Number of entries per State/Territory

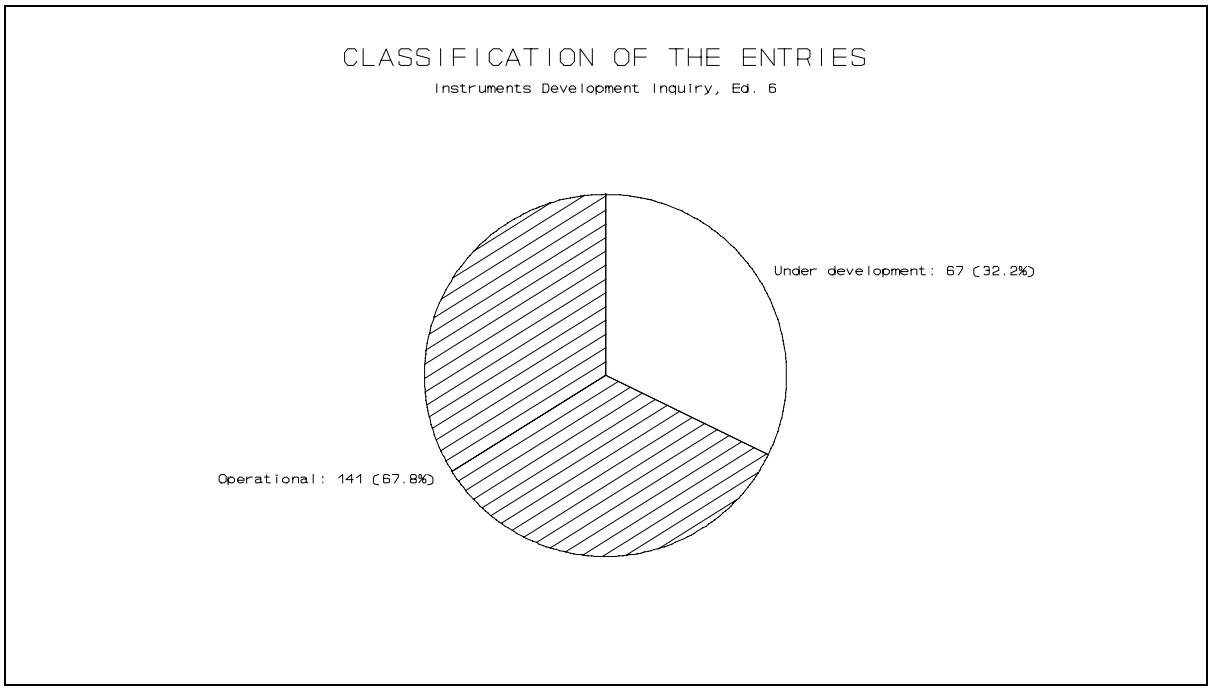

Fig. 2 Classification of the entries

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:

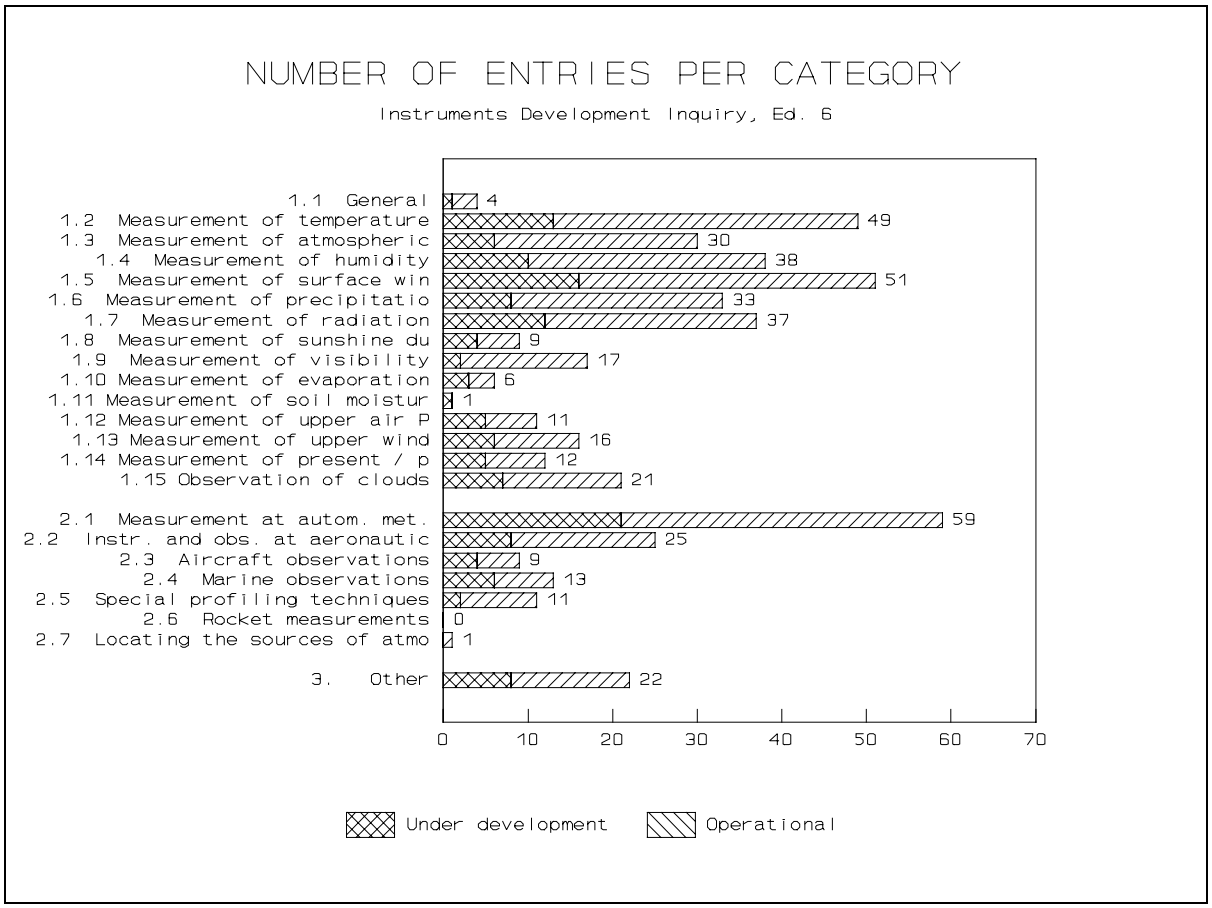

Fig. 3 Number of entries per category

Categories, indicated under "3. Other" were typical "Icing" and "Freezing point measurements". From this diagram it is clearly demonstrated that the development of *automatic stations* (Synoptical, climatological or aeronautical) is the most popular item (cat. 2.1). Other categories which are currently in the picture are the well known classical categories like 1.5 Measurement of surface wind and 1.2 Measurement of temperature.

COUNTRY/CAT.	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11	1.12	1.13	1.14	1.15	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3.
Australia		2 [1]		1 [1]		1 [1]			1 [1]						1 [1]	5 [4]	2 [2]					1 [1]	
Canada						3 [2]	1 [1]								2 [2]	2 [1]			1 [1]				1 [1]
China		9 [9]	4 [4]	5 [5]	10 [9]	5 [5]	2 [2]					1	3 [1]	1	1 [1]		1		1	2 [2]			
Finland		6 [5]	5 [3]	5 [4]	7 [3]	3 [3]			6 [6]			3 [2]	3 [2]	3 [3]	3 [3]	4 [4]	2 [2]	1 [1]		3 [3]			1 [1]
Germany							1	1						2	1	3							1
Hong Kong																1 [1]							
Japan		1 [1]	1 [1]		2 [2]		3 [2]	1 [1]	1 [1]			1 [1]				1 [1]	1 [1]						
Kuwait												1 [1]											
Lithuania							1 [1]																
Mexico												1 [1]				1 [1]							
Netherlands			1	2	1 [1]			1 [1]	3 [3]	1 [1]				1 [1]		5 [2]	1 [1]	1	1 [1]				1 [1]
Norway		1 [1]			1 [1]																		
Pakistan						1																	
Philippines		1																					
Poland		2 [2]	2 [2]	2 [2]	2 [2]											2 [2]							
Portugal		8 [8]	8 [8]	8 [8]	8 [8]	8 [8]	8 [8]																
Russian Fed.		4										1	1							2 [2]			
Singapore		1 [1]	1 [1]		1 [1]	1 [1]	1 [1]					1 [1]	2 [2]			1 [1]							1 [1]
Slovakia								1								1							
South Africa		2 [1]	1 [1]	2 [1]		1 [1]										1 [1]							3 [2]
Sweden		1 [1]	1 [1]	2 [1]	1 [1]	1 [1]			1 [1]					2 [2]	1 [1]	2 [1]				1			1 [1]
Switzerland	1 [1]			1 [1]																			
Thailand			1 [1]		1 [1]		1 [1]						1										2
Ukraine															1								
U.K.						2								1	2 [1]	2 [1]							
U.S.A.	3 [2]	10[6]	5 [2]	10[5]	17[6]	7 [3]	16[9]	5 [3]	5 [3]	5 [2]	1	2	6 [5]	2 [1]	9 [5]	27[18]	18[11]	7 [4]	10[5]	3 [2]			10[7]
Uzbekistan		1					3									1							1
Total	4 [3]	49[36]	30[24]	38[28]	51[35]	33[25]	37[25]	9[5]	17[15]	6[3]	1	11[6]	16[10]	12[7]	21[14]	59[38]	25[17]	9 [5]	13[7]	11 [9]		1 [1]	22[14]

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

Category Index:

1.1 General
1.2 Measurement of temperature
1.3 Measurement of atmospheric pressure
1.4 Measurement of humidity
1.5 Measurement of surface wind
1.6 Measurement of precipitation
1.7 Measurement of radiation
1.8 Measurement of sunshine duration
1.9 Measurement of visibility
1.10 Measurement of evaporation
1.11 Measurement of soil moisture
1.12 Measurement of upper air pressure, temperature, humidity
1.13 Measurement of upper wind
1.14 Measurement of present and past weather, state of the ground
1.15 Observation of clouds

2.1 Measurement at automatic meteorological stations
2.2 Instruments and observations at aeronautical stations
2.3 Aircraft obseravtions
2.4 Marine observations
2.5 Special profiling techniques for the boundary layer and the troposphere
2.6 Rocket measurements in the stratosphere and mesosphere
2.7 Locating the sources of atmospherics

3.0 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 still (like with the previous inquiry) runners up: Optical techniques are involved in the measurements of radiation, cloud observations, present weather observations, humidity, precipitation, visibility, sunshine duration. Optical technolies are especially used in instruments to automize *visual observations*. On the other hand it must be noted that the use of microprocessors (inside sensors/transmitter, or inside datalogging systems) is now a widespread phenomenon.

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, 5. Less maintenance, 6. Improved quality control, and 7. Data reduction. 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.

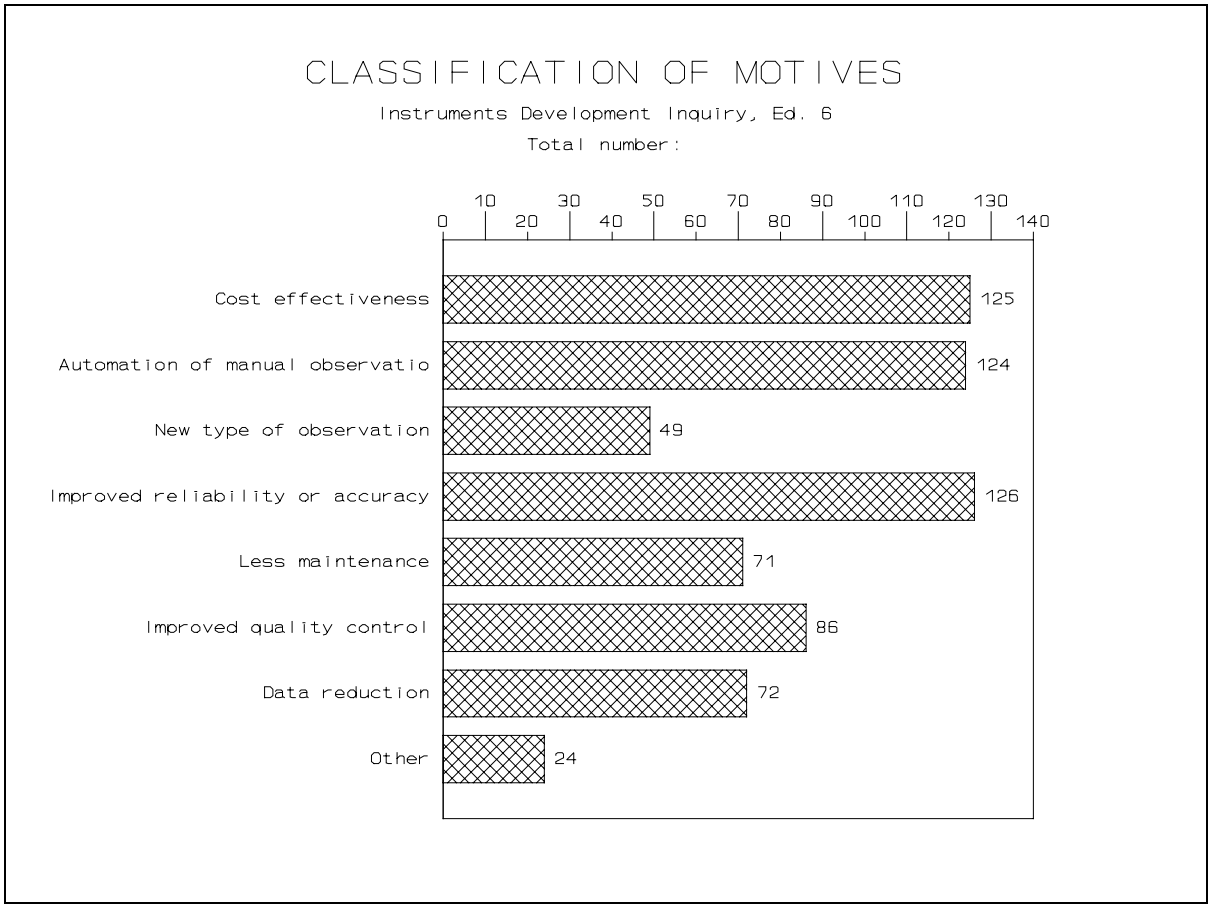

Fig. 4. Classification of motives

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

- Additional information
- Compact, light weight, small size, fast install, integrated technology
- Compact construction and simple operation requirements
- Designed for network operation
- Improved calibration and documentation

- Improved cosine response
- Improved response time
- Improved/more efficient presentation of data
- More efficiency
- PC or Mac-based, low cost
- possibility of measurement points dispersion in vast areas
- Scalable architecture suitable for large networks
- Suitability for aircraft use (Model TSP-700A)
- Technology upgrade
- Technology upgrade
- Thermal stabilization
- To make up for lack of personnel. Real time information.
- Updating radiosonde network
- use for magnetometer for north reference
- very wide measurement range
- Wind shear/microburst prediction

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

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

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, 45% more than for the previous inquiry,
- Cost effectiveness, 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. Notice that the development for such systems is focused merely on interfacing of received information by using microprocessors 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.
- 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

List of Categories[1])

1. Measurement of Meteorological Variables

1.1 General
1.2 Measurement of temperature
1.3 Measurement of atmospheric pressure
1.4 Measurement of humidity
1.5 Measurement of surface wind
1.6 Measurement of precipitation
1.7 Measurement of radiation
1.8 Measurement of sunshine duration
1.9 Measurement of visibility
1.10 Measurement of evaporation
1.11 Measurement of soil moisture
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1.14 Measurement of present and past weather, state of the ground
1.15 Observation of clouds

2. Observing Systems

2.1 Measurement at automatic meteorological stations
2.2 Instruments and observations at aeronautical stations
2.3 Aircraft observations
2.4 Marine observations
2.5 Special profiling techniques for the boundary layer and the troposphere
2.6 Rocket measurements in the stratosphere and mesosphere
2.7 Locating the sources of atmospherics

3. Other

Classifications

1 Instruments under development
2 Instrument put in operational use in recent 4 years

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1) The numbering applied is chosen to the numbers of chapters used in the sixth edition of the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8)

1.1. Measurement of Meteorological Variables

1.1.1. General

-None-

Other entries related to this category:
1.1.10.1

1.1.2. Measurement of temperature

Identification number: **1.1.2.1.** [003]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The DTV type air temperature sensor converts temperature into an electric pulse frequency
2. *State of development*: Experimental prototype
3. *Principle of operation*: The air temperature is converted into a voltage using the K1019EMI integral microscheme, them into an electric pulse frequency

Main technical characteristics

4.1	*application*:	Thermometry and meteorology
4.2	*measuring range*:	-45 to +55 °C
4.3	*uncertainty*:	±0.3 °C in the full measurement range
4.4	*time constant*:	1.5 - 2 min.
4.5	*averaging time*:	1 s
4.6	*reliability*:	10,000 hours
4.7	*interface and output details*:	Binary code in TTL standard
4.8	*power requirements*:	38±2 V DC
4.9	*servicing interval*:	1 year

4.10 *other characteristics*:
The sensor is made to order with the following output characteristics: F = 10.T °K, F = 10.T °C, F = 10.T °K - $F_0$6, where F is the output frequency

Experiences and other information

5. *Experience from comparisons and tests performed*:
The error of the converters based on K1019EMI in the temperature range does not exceed ±0.2°C

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

7. *Name and adress of person responsible for further information*:

Mr Leonid A. Kanaev
NPP Gidrometpribor
4, Kh. Asomov Street
700084 Tashkent
Uzbekistan

Telephone: 34 93 61
Telefax: 34 74 89
E-mail:
URL: http://

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

Identification number: **1.1.2.2.** [053]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* 100-Day Datalogging Weather-Station, Model 40AM166; digitally wind-speed, direction;air temp., rel. humidity;baro. pressure; rainfall, solar-energy (pyranometer) and soil/water temp.
2. *State of development*: Production scheduled for Spring 1998
3. *Principle of operation*: Compact probe-outputs converted by A/D modules to serial-data of 8-channel log by rechargeable batteries & solar-panel. Loager stores 72K readings of each, expandable to 144K in point-storage mode (much more in adaptive mode)

Main technical characteristics

4.1	*application*:	portable logger for major parameters at any site
4.2	*measuring range*:	0 to 50 m/s, 0 to 360°az, -20 to +55°C, 0 to 100%RH, 800 to 1040 hPa, rain: unlimited (x0.5mm), 0 to 2.3 mWh/cm^2, soil/water temp.: -30 to +50°C
4.3	*uncertainty*:	3% or less
4.4	*time constant*:	10 seconds or less; wind-wheel d.c.=2.3 m, vane=0.5 m; Anemometer damping ratio: 0.2
4.5	*averaging time*:	N/A; computer selectable
4.6	*reliability*:	ca. 3 years MTBF (depending upon site conditions)
4.7	*interface and output details*:	RS232, 9600 baud
4.8	*power requirements*:	110 V, 60 Hz or 220 V, 50 Hz, for the battery chargers
4.9	*servicing interval*:	100 days

4.10 *other characteristics*:
Compact, rugged-probes (moulded thermoplastic wind-probes, solid-state air temp. and humidity sensors in self aspirating shelter and solid-state barom. pressure sensor) with a fiberglass reinforced NAME enclosure for them and electronics/logger/batteries/solar-panel provide lightweight, weather tightness and portability. These mounted probes can optionally be removed for remote exposure. Rain (tilting bucket, with integral funnel and housing) and solar-energy (star pyranometer) probes have signal cables for remote mounting. Optional memory-expansion modules permit unloading loggers' data and bringing them to IBM-compatible PC (for processing with DOS or Window 95), which allows loggers to remain in the field and continue to collect data, instead of removing them and bringing them to the computer.

Experiences and other information

5. *Experience from comparisons and tests performed*:
These probes have been used for over 10 years, to obtain land- or sea-data; this new logger has more memory.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 150 (calibr. RH soln.)

7. *Name and adress of person responsible for further information*:

Dr Gerald Kahl
Kahl Scientific Instrument Corp.
P.O. Box 1166
El Cajon, CA 92022-1166
USA

Telephone: (619) 444-2158
Telefax: (619) 444-0207
E-mail: kahl@kahlsico.com
URL: http://

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

Identification number: **1.1.2.3.** [059]
Country: **South Africa**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Electronic measurement of temperature and humidity and displaying of data, as well as storing of data every minute on a memory module
2. *State of development*: Final stages before testing
3. *Principle of operation*: Capacitive humidity sensor Vaisala HMP45 PRT temperature sensor coupled to a logger with display. replaces thermohygrograph

Main technical characteristics

4.1	*application*:	Measuring of temperature and humidity electronically and storing of data on a logger
4.2	*measuring range*:	Temp.: -20 to +50°C, hum.: 0 to 100%RH
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	Very reliable
4.7	*interface and output details*:	Storage module sent to weather office monthly where downloaded onto PC.
4.8	*power requirements*:	12 V storage battery and solar panel
4.9	*servicing interval*:	Monthly to change storage module
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*:	Postage, observers remuneration

7. *Name and adress of person responsible for further information*:

Mr A. (Riaan) J. Lourens
Irene Weather Office
Private Bag X08
Irene, 0062
Rep. of South Africa

Telephone: (012) 6651589
Telefax: (012) 6651594
E-mail:
URL: http://

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

Identification number: **1.1.2.4.** [105]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* This system provides accurate cloud profiles, temperature readings at different elevations, barometric pressure, and cloud coverage percentages. In addition this unit can detect wind speed and direction.
2. *State of development*: Development of baseline prototype design and validation of existing AIMS technology.
3. *Principle of operation*: The instrument measures the water vapour profile based on the vibrational Raman scattering and the temperature profile based on the rotational Raman scattering. These measurements provide real-time profiles of RF refractivity. Profiles are stored each minute with a vertical resolution of 75 meters from the surface to 7 km. The prototype instrument, which includes several subsystems to automate and monitor operation, has been designed to provide the real-time measurements of profiles.

Main technical characteristics

4.1	*application*:	Atmospheric Profile Sensor
4.2	*measuring range*:	75 meters to 7 km to within 20 meters
4.3	*uncertainty*:	Below 2 km: less than fraction of a degree; Above 2 km; error increases
4.4	*time constant*:	Real time
4.5	*averaging time*:	
4.6	*reliability*:	Test unit operated continuously for 24 and 36 hour periods with no complications, Test unit operated in all weather conditions with no complications. Tbc instrument features self-calibration, performance testing, and built-in tests to check many functions
4.7	*interface and output details*:	RS232
4.8	*power requirements*:	Standard
4.9	*servicing interval*:	Some units feature self-calibrating mechanisms. Service as needed.
4.10	*other characteristics*:	
	N/A	

Experiences and other information

5. *Experience from comparisons and tests performed*:
A prototype instrument was fabricated during FY95/96 and has been deployed on the USS Sumner, a Navy survey ship, in the Gulf Of Mexico and along the Atlantic coast of Florida during September/October 1996 to perform tests and validate its performance, The instrument was used to gather 356 hourly subdirectories of data. Measurements were made in all weather conditions and the instrument was available 99% of the time. The instrument measured water vapour, temperature profiles, true extinction, and ozone profiles. LIDAR data was compared to data from a rawindsonde balloon over same time period and location. The LIDAR data collected when compared to the balloon data confirmed that the laser error below 2 km is minimal. Above 2 km, however, error increases.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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2045 Bennett Road,
Philadelphia, PA, 19116,
USA

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Telefax:	215-464-9303
E-mail:	dhayes@warrenind.com
URL:	http://warrenind.com

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

Identification number: **1.1.2.5.** [106]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The complex (Module for soil temperature measurements AMT-5) contains one measuring/transmission unit, one collection unit (common for MT-3) and some sensors, are lowered to selected depths.
2. *State of development*: The stage of field test
3. *Principle of operation*: Measured data are stored for further remote readout using infrared channel

Main technical characteristics

4.1 *application*: The main function is soil temperature measurements on 8 levels
4.2 *measuring range*: -50 to +50°C
4.3 *uncertainty*: ±0.2°C
4.4 *time constant*: N/A
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: U = 24/36 VAC; battery: U = 9 V, P = 0.08 W
4.9 *servicing interval*: N/A
4.10 *other characteristics*:
Sensors are designed on semiconductor chip base. Collection unit provides collection/storage/calculation and removal of data to computer and/or digital display. There is an automatic "low" battery control. The distance of readout is up to 8 m.

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 adress of person responsible for further information*:

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Telefax: (7)(095)2552225
E-mail:
URL: http://

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

Identification number: **1.1.2.6.** [107]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The complex (Module for air temperature measurements MT-3) contains one measuring/calculation unit, one collection unit (common for AMT-5), and a pair of dry and wet thermometers on semiconductor chip base.
2. *State of development*: The stage of field test
3. *Principle of operation*: Measured data are stored for further remote readout using infrared channel

Main technical characteristics

4.1 *application*: Meteorology
4.2 *measuring range*: -50 to +50°C
4.3 *uncertainty*: ±0.2°C
4.4 *time constant*: N/A
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: U = 24/36 VAC; battery: U = 9 V, P = 0.06 W
4.9 *servicing interval*:
4.10 *other characteristics*:
Measuring/calculation unit provides measurements, minimum/maximum calculation, storage and removal of data to collection unit, which provides collection/storage/calculation and removal of data to computer and/or digital display. The distance of readout is up to 1 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 adress of person responsible for further information*:

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

Identification number: **1.1.2.7.** [108]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The device (Portable thermometer AMT-2) contains one measuring unit, one portable and one stationary sensors and provides temperature measurements in gaseous, friable and liquid mediums.
2. *State of development*: The stage of a field test
3. *Principle of operation*: Measured data can be transmitted in real time regime or stored for further remote readout.

Main technical characteristics

4.1 *application*: The main function is temperature measurements in an arable layer during vegetation studies.
4.2 *measuring range*: -30 to +60°C
4.3 *uncertainty*: ±0.5°C
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: RS232
4.8 *power requirements*: U = 9 V
4.9 *servicing interval*:
4.10 *other characteristics*:
One measurement unit operates up to 9 stationary sensors with miniature copper resistance thermometer.

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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **1.1.2.8.** [109]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The complex (Thermometer AM 34) contains one readout unit and some measuring/registration underground units. Miniature copper resistance thermometers are lowered to a selected depth of rootlet centre.
2. *State of development*: The stage of a field test
3. *Principle of operation*: Measured data are stored for further remote readout using a wireless channel. The distance of readout is up to 3m.

Main technical characteristics

4.1 *application*: Agriculture studies.
4.2 *measuring range*: -30 to +40°C
4.3 *uncertainty*: ±0.5°C
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*:
One readout unit can operate up to 9 measuring/registration units. Overhanging elements of design are lacking. Maximum/minimum data are stored between observation periods. Autonomous operation time of measuring/registration units - up to one year.

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 adress of person responsible for further information*:

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

Identification number: **1.1.2.9.** [182]
Country: **Australia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Pt100 RTD, soil temperature probes for a variety of depths: 5, 10, 20, 50 to 100 cm.
2. *State of development*: Final prototype
3. *Principle of operation*:

Main technical characteristics

4.1	*application*:	Soil temperature
4.2	*measuring range*:	-10 to 60°C
4.3	*uncertainty*:	0.2°C
4.4	*time constant*:	Grass, 5, 10, 20 cm probe: 50 s (in oil), 50 to 100 cm: 115 cm (in oil)
4.5	*averaging time*:	1 s, 1 min, 10 min
4.6	*reliability*:	
4.7	*interface and output details*:	4 wire resistance measurement
4.8	*power requirements*:	
4.9	*servicing interval*:	unknown
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Laboratory test satisfactory. Field trial commence september 1997.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **1.1.2.10.** [196]
Country: **Philippines**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Thermometer with Thermistor as Sensor: The instrument uses thermistor as the sensing element
2. *State of development*: Experimentation on the relationship of temperature and resistance is currently undertaken
3. *Principle of operation*: The thermistor changes in resistance as temperature changes

Main technical characteristics

4.1 *application*: To be used for temperature measurement
4.2 *measuring range*: 5°C to 45°C
4.3 *uncertainty*:
4.4 *time constant*: No time constant
4.5 *averaging time*: No averaging time. Only warm up for 5 minutes before taking readings.
4.6 *reliability*: 90%.
4.7 *interface and output details*: The thermistor is connected in series w/ a resistor as one branch of a Wheatstone bridge circuit and the output of that circuit is coupled to a transistor w/ the meter at the collector circuit.
4.8 *power requirements*: Two power sources: Regulated 9V at bridge circuit, Regulated 9V at transistor Ckt.
4.9 *servicing interval*:
4.10 *other characteristics*:
The thermistor thermometer uses three ranges from 5° to 45°C to get more linearized response at the output of the bridge circuit so that three resistors are used in series to be selected for each range with the thermistor as one branch and corresponding three resistors similarly switched and selected at the other branch of the circuit.

Experiences and other information

5. *Experience from comparisons and tests performed*:
There was no experience yet in actual observation but only in the calibration of the thermistor thermometer.

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

7. *Name and adress of person responsible for further information*:
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Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
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Telefax:
E-mail:
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Markus, J.T.: Modern Electronic Circuits Reference manual, pp 1050
- Simidchieve, D.A.: Compendium of Lectures Notes on Meteorological Instruments, WMO, pp 55 - 57

Other entries related to this category:
1.1.03.2, 1.1.04.1, 1.2.04.2, 2.1.05.9
2.1.13.3, 2.2.01.2, 2.2.01.3

1.1.3. Measurement of atmospheric pressure

Identification number: **1.1.3.1.** [025]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The system consists of an electronic barometer transducer and datalogger with display for measurement and recording of barometric pressure
2. *State of development*: Long term testing phase. The pressure transducer is well known for its stability.
3. *Principle of operation*: Pressure transducer: Capacitive sensor, Datalogger: Sample interval software adjustable

Main technical characteristics

4.1	*application*:	Any application where recording of bar. pressure is needed.
4.2	*measuring range*:	600 to 1100 hPa or 800 to 1100 hPa
4.3	*uncertainty*:	0.25%FS
4.4	*time constant*:	10 ms (from 0 to 90% of final output)
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	Output of pressure transducer: 0.1 to 5.1 VDC
4.8	*power requirements*:	Pressure transducer: 24 VDC, datalogger: Internal battery
4.9	*servicing interval*:	The Wittich & Visser barologger is an integrated system consisting of a high accuracy and stable pressure sensor, display and one-channel datalogger with versatile software.
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 adress of person responsible for further information*:

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Telefax: (070) 3070938
E-mail: wittich@xs4all.nl
URL: http://

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

Identification number: **1.1.3.2.** [156]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PTU200 series PTU transmitters: atmospheric (surface) pressure + air temperature + relative humidity
2. *State of development*: To be launched in January 1998.
3. *Principle of operation*: - uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - uses a Pt100 or a Pt1000 temperature sensor
   - uses the HUMICAP® thin film polymer humidity sensor
   - microprocessor electronics performing high order linearization and thermal compensation
   - available with integrated radiation shield and static pressure head for outdoor use

Main technical characteristics

4.1	*application*:	measurement of atmospheric (surface) pressure, air temperature and relative humidity
4.2	*measuring range*:	500 to 1100 hPa abs. / -40 to +60°C / 0 to 100%RH
4.3	*uncertainty*:	±0.01% reading / ±0.10 hPa / ±0.2 hPa / ±0.3 hPa / ±0.5°C / ±2 to 3%RH
4.4	*time constant*:	
4.5	*averaging time*:	1 to 60 s
4.6	*reliability*:	
4.7	*interface and output details*:	RS232C /TTL level / RS485 / RS422 serial interface; external on/off triggering possible
4.8	*power requirements*:	10 to 30 VDC / 25 to 50 mA
4.9	*servicing interval*:	1 to 3 years

4.10 *other characteristics*:
- configurable transmitter with several options (accuracy classes, number of pressure transducers etc.)
- available with one or two internal pressure transducers for redundant pressure measurement
- available with both Pt100 and Pt1000 temperature sensors
- available with integrated radiation shield and static pressure head for outdoor use

Experiences and other information

5. *Experience from comparisons and tests performed*:
Long-term stability of atmospheric pressure measurement is generally within ±0.1 hPa per year in the field use and typically ±0.05 hPa per year in room temperature use. The HUMICAP® thin film polymer humidity sensor has a ten-year field record in outdoor measurements in automatic weather station use.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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P.O.Box 26
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Telefax: (+358 9) 8949485
E-mail: pekka.jarvi@vaisala.com
URL: http://www.vaisala.com

8. *Major bibliographic references, applicable patents, etc.:*
Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor and HUMICAP® thin film polymer humidity sensor of Vaisala.

Identification number: **1.1.3.3.** [159]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PMB100 series barometer modules: atmospheric (surface) pressure
2. *State of development*: To be launched in the market in January 1998.
3. *Principle of operation*: - the module uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - the modules consist of the pressure sensor and basic measurement interface electronics only
   - a separate temperature sensor is needed for thermal compensation
   - an EEPROM contains all individual pressure and temperature coefficients of a module
   - module interfaces directly with an AD converter with input range from 0 to 2.5 VDC
   - a microprocessor is needed for calculation of compensated pressure

Main technical characteristics

4.1	*application*:	measurement of atmospheric (surface) pressure
4.2	*measuring range*:	PMB100A: 900 to 1100 hPa / -40 to +60°C PMB100B: 500 to 1100 hPa / -40 to +60°C
4.3	*uncertainty*:	±0.3 hPa / ±0.5 hPa / ±0.8 hPa, accuracy depending on pressure and temperature range
4.4	*time constant*:	
4.5	*averaging time*:	about 1 s
4.6	*reliability*:	MTBF
4.7	*interface and output details*:	0 to 2.5 VDC output (+ reference voltage), external on/off triggering possible
4.8	*power requirements*:	8 to 30 VDC / 3 mA
4.9	*servicing interval*:	1 to 3 years
4.10	*other characteristics*:	

- designed for modern systems demanding integrated atmospheric (surface) pressure measurement
- the PMB100 modules are intended to be mounted directly on a circuit board

Experiences and other information

5. *Experience from comparisons and tests performed*:

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	(Information not available)

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
   Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala.

Other entries related to this category:

1.1.02.2	2.1.02.11	2.1.02.22	2.1.02.27	2.2.01.2
1.1.02.4	2.1.02.12	2.1.02.23	2.1.02.28	2.2.01.3
1.2.04.2	2.1.02.13	2.1.02.24	2.1.02.29	
2.1.02.1	2.1.02.15	2.1.02.25	2.1.02.30	
2.1.02.8	2.1.02.17	2.1.02.26	2.1.05.12	

1.1.4. Measurement of humidity

Identification number: **1.1.4.1.** [007]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Humidity, temperature & water activity measurement on MEMS silicon die.
2. *State of development*: Complete patent issued Oct 8, 1996. International patents being pursued. Test preproduction die performance is confirmed by HMX, Motorola, RdF, Batterle & DERA (England). Die crat-net manufactured by SMI/EXAR, paciramed by Pelagic.
3. *Principle of operation*: Hygro shear/stress force of 5 micron polymer coating to contilera beam instermuted with diffused strain gates. First unit 2 mm square, flow through construction, fail bridge, humidity & temperature. Gager on a common epitaxial layer.

Main technical characteristics

4.1	*application*:	Humidity and water activity (a_w)
4.2	*measuring range*:	0 - 100 %RH, 0 - 1 a_w
4.3	*uncertainty*:	< ±1%
4.4	*time constant*:	< 1 s (one time constant)
4.5	*averaging time*:	N/A
4.6	*reliability*:	All Silicon MEMS construction, highest reliability
4.7	*interface and output details*:	Humidity full bridge 3500 ohm; 10 mV per Volt. Output 0 - 100%RH, resolution infinite
4.8	*power requirements*:	Microvolt to 10 VDC excitation. AC excitation OK.
4.9	*servicing interval*:	Indefinite - No deterioration or drift yet detected
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Hygrometrix and Fenner Associates have been in the manufacture of humidity and water activity sensors & systems based on strain gage technology for 27 years. We have a 30,000 strain gage sensors performance database which includes an extension through the new MEMS technology

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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978 Peutz Valley Road
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E-mail: hmxinc@hygrometrix.com
URL: http://www.hygrometrix.com

8. *Major bibliographic references, applicable patents, etc.:*
- (1972) Paper on Cellulose Crystalline Sensors
- Patent on MEMS

Identification number: **1.1.4.2.** [023]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Lyman-Alpha elements radiate at certain hydrogen emission lines. The absorption at these frequencies of air, and therefore humidity is measured.
2. *State of development*: Testing phase.
3. *Principle of operation*: Hydrogen gas is heated. Lyman-Alpha emission frequencies are created. Radiation at this frequency is absorbed by water vapour in air.

Main technical characteristics

4.1	*application*:	Humidity measurement by radiation absorbtion
4.2	*measuring range*:	0 to 100%RH
4.3	*uncertainty*:	2%RH
4.4	*time constant*:	Approx. 5 ms
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	0 to 10 V
4.8	*power requirements*:	Max. 5 W power consumption
4.9	*servicing interval*:	
4.10	*other characteristics*:	

The new Lyman-Alpha elements are the sources for the Lyman-Alpha hygrometer. They have been designed for longer life cycle in comparison with the existing elements.

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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **1.1.4.3.** [024]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Wittich & Visser leaf-wetness sensors detects condensation on a surface.
2. *State of development*: Prototypes have been tested
3. *Principle of operation*: Condensation on a surface is detected by a beam of infrared radiation directed on the glass measurement surface. the diffusion is an indicator for leaf-wetness.

Main technical characteristics

4.1	*application*:	Leaf-wetness measurement in greenhouses
4.2	*measuring range*:	Near 100%RH
4.3	*uncertainty*:	
4.4	*time constant*:	Fast response depending on glass thickness
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	Output: 750 to 1250 mV
4.8	*power requirements*:	220 VAC, 50 Hz or 12 VDC
4.9	*servicing interval*:	
4.10	*other characteristics*:	

The new leaf-wetness sensor measures surface wetness by means of infrared reflection on a measurement surface. The probe is intended for use in a greenhouse environment. Apart from surface wetness the sensor may be used to detect imminent surface wetness.

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 adress of person responsible for further information*:

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URL:	http://

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

Identification number: **1.1.4.4.** [028]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* This instrument called a saturation hygrometer measures ambient relative humidity (RH) in a range centred about the saturation vapour pressure where RH = 100%. Measures of supersaturation (RH > 100%) are obtained.
2. *State of development*: First prototype constructed and flown on a motorized airship
3. *Principle of operation*: Condensation nuclei located on a thermally-thin and hydrophobic substrate change their size with RH; size change is sensed optically. For conditions of RH > 100% an infrared heater keeps the solution droplets at a constant size; the temperature increase of the substrate is directly proportional to the supersaturation

Main technical characteristics

4.1 *application*: Research in cloud physics
4.2 *measuring range*: 95% to 105% RH
4.3 *uncertainty*: 0.02% at RH = 100%; 1% at RH = 97%
4.4 *time constant*: 0.5 s
4.5 *averaging time*: N/A
4.6 *reliability*: Substrate is relatively short-lived, but expendable and replaceable
4.7 *interface and output details*: Two analog channels; one for RH < 100%, one for RH > 100%.
4.8 *power requirements*: 10 W
4.9 *servicing interval*: Unknown
4.10 *other characteristics*:
The saturation hygrometer is calibrated in the field by immersing the probe into an insulated box in which RH is kept at 100%. This fixes the operation point of the hygrometer, which has a channel for measuring RH < 100%, and a second channel for measuring RH > 100%. The former channel obtains a measure of RH by observing optically the change in the scattered light by the solution droplets formed on the condensation nuclei, while the latter measures the supersaturation by relating the temperature increase of the hygrometer substrate to the vapour pressure. A thermo-optical servo loop keeps the droplets at their 100% size during periods of supersaturation. The hygrometer is sensitive to the surrounding black-body radiation, and so is protected by a thermally-thin radiation shield.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparison of supersaturations generated by a large thermal-gradient diffusion chamber (continuous flow), and supersaturations calculated from the temperature increase of the hygrometer substrate agreed well. Measurements in fog showed stable operation and lack of hysteresis effects in the hygrometer.

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

7. *Name and adress of person responsible for further information*:

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1643 Bentana Way
Reston, VA 20190
USA

Telephone: 703-742-9844
Telefax: 703-742-3374
E-mail: gerber@access.digex.net
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Gerber, H, 1994: "Hygrometer for measurement of relative humidity in clouds". Final Report SBIR Phase I No. 9261243, pp. 19 (National Science Foundation, Washington, DC, USA)

Identification number: **1.1.4.5.** [102]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The instrument measures the relative humidity and temperature of air at the location of the RH and T transducers. This air sample is ambient air that has been heated to lower its relative humidity. The temperature of the actual ambient air is also measured. The RH and dewpoint of the ambient air is then computed by the instrument computer system
2. *State of development*: Commercial instrument purchased. Test and evaluation being planned
3. *Principle of operation*:

Main technical characteristics

4.1	*application*:	Ambient air is heated by an electrical element before the air sample reaches a small relative humidity transducer. The dewpoint of the air sample is calculated using the measured values of RH and T. The relative humidity of the ambient air is also calculated based on the measured value of dewpoint and air temperature.
4.2	*measuring range*:	relative humidity measurements
4.3	*uncertainty*:	20%RH to 100%RH
4.4	*time constant*:	±2%RH
4.5	*averaging time*:	Not known
4.6	*reliability*:	Not known
4.7	*interface and output details*:	Digital, serial RS232/485
4.8	*power requirements*:	Undermined, but > 1 W
4.9	*servicing interval*:	1 year
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
No field experience at NDBC

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 300

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Vaisala technical manual for humidity sensors

Other entries related to this category:

1.1.02.2	2.1.02.3	2.1.02.16	2.1.02.26
1.1.02.3	2.1.02.5	2.1.02.17	2.1.02.27
1.1.02.4	2.1.02.6	2.1.02.19	2.1.02.28
1.1.03.2	2.1.02.10	2.1.02.20	2.1.02.29
1.2.05.1	2.1.02.11	2.1.02.21	2.1.02.30
2.1.01.1	2.1.02.12	2.1.02.23	2.1.02.31
2.1.02.1	2.1.02.13	2.1.02.24	2.2.01.2
2.1.02.2	2.1.02.15	2.1.02.25	2.2.01.3

1.1.5. Measurement of surface wind

Identification number: **1.1.5.1.** [031]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Airport Surveillance Radar, ASR-9
2. *State of development*: Prototype successfully tested, entering production phase
3. *Principle of operation*: Doppler weather radar technology applied to existing Air Traffic Control Radar. Automated image analysis to detect wind shear and estimate storm motion

Main technical characteristics

4.1	*application*:	Wind shear detection and storm tracking
4.2	*measuring range*:	0 to 60 nmi
4.3	*uncertainty*:	
4.4	*time constant*:	30 s (update period)
4.5	*averaging time*:	30 s
4.6	*reliability*:	> 0.9 availability and probability of detection
4.7	*interface and output details*:	Input from ASR-9 output to dedicated displays
4.8	*power requirements*:	Approx. 2000 W
4.9	*servicing interval*:	Approx. 3 months
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Prototype operational testing began 1990 and has continued thereafter: Very good operational acceptance by Air Traffic Controller's exposed to the prototype system products.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Approx. US$ 25,000

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- "Low Altitude Wind Shear Detection using Airport Surveillance Radars", IEEE AES 10(1995)3-5
- "ASR-9 WSP Provides Significant and Affordable Enhancement to Terminal Weather Surveillance", Journal of ATC 38(1996)41-45

Identification number: **1.1.5.2.** [055]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* 100-Day Datalogging Anemograph, Model 02BM315; digitally records wind speed (0-50 m/s) and direction (0-360°), 36K of each (min.)
2. *State of development*: Production scheduled for Fall, 1997
3. *Principle of operation*: 3-cup anemometer produces AC voltage, vane-coupled potentiometer produces DC voltage from circuit, both converted by A/D modules to serial-data of logger, powered by rechargeable batteries. Logger stores 36,000 readings of each (expandable to 324,000).

Main technical characteristics

4.1	*application*:	Collection of wind data in remote locations
4.2	*measuring range*:	speed: 0 to 50 m/s; direction: 0 to 360° azimuth
4.3	*uncertainty*:	0.5%
4.4	*time constant*:	Cup-wheel distance-constant = 2.3 m; vane d.d. = 0.5 m
4.5	*averaging time*:	N/A
4.6	*reliability*:	ca. 5 years MTBF (depending upon site-conditions)
4.7	*interface and output details*:	RS232, 9600 baud
4.8	*power requirements*:	110 V, 60 Hz or 220 V, 50 Hz, for battery chargers
4.9	*servicing interval*:	100 days

4.10 *other characteristics*:
Moulded thermoplastic probe components and fiberglass reinforced NEMA enclosure for electronics/logger/batteries provide exceptionally good corrosion-resistance, as well as lightweight (for optimal sensor-response and portability) and weathertight integrity (for use in any climate). Optionally, probes can be removed from the enclosure for exposure some distance away. Optional memory-expansion module can be used to unload logger's data and bring them to IBM compatible PC (for processing with DOS 3.0 or Windows 95), which allows logger to remain in the field and continue to collect data.

Experiences and other information

5. *Experience from comparisons and tests performed*:
These probes have been used for over 10 years, to obtain data on land or at sea; this new logger has more memory than the original.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Nil (batteries, wicks)

7. *Name and adress of person responsible for further information*:

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E-mail: kahl@kahlsico.com
URL: http://

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

Identification number: **1.1.5.3.** [069]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:*
Anemorumbometer with standard wind pipe to identify.

2. *State of development*: EN Anemorumbometer is under development, and tested in the weather station EY1 Electrical transmission anemorumbometer is put into operational use

3. *Principle of operation*: Digital display, with automatic printing and output port are in the instrument

Main technical characteristics

4.1 *application*: Used in meteorological station, harbor, port
4.2 *measuring range*: Wind direction: 0 to 360°, wind speed: 0.5 to 70 m/s
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 VAC, 50 z or 12 VDC
4.9 *servicing interval*: 12 months
4.10 *other characteristics*:
EL Electrical Contact Anemorumbometer
EY1 Electrical Transmission Anemorumbometer
EY1-2B Electrical Transmission Alarm Instrument
EDE-1A Hand held Digital Anemometer
ZZ6-4 Ship Meteorological Set

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 adress of person responsible for further information*:
Shanghai Meteorological Instrument Factory
270, Chuan Gong Road
Shanghai
P.R. China
Telephone: (021) 56636730
Telefax: (021) 56638934
E-mail:
URL: http://

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

Identification number: **1.1.5.4.** [093]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HOLODAR@ Model 700 remotely measures atmospheric turbulence and wind parameters along a single path using a stable or fixed location.
2. *State of development*: Working prototype
3. *Principle of operation*: Measures crosswinds and atmospheric turbulence (atmospheric, pollution tracking, weapons systems, etc) and fluid flows. This device with its lange optics holographic filters achieves greater range and resolution than other sensors.

Main technical characteristics

4.1	*application*:	measuring wind speed, wind direction and turbulence
4.2	*measuring range*:	five hundred to ten thousand meters
4.3	*uncertainty*:	8 to 10%
4.4	*time constant*:	10 s
4.5	*averaging time*:	30 s
4.6	*reliability*:	high reliability and no moving parts
4.7	*interface and output details*:	to be determined by customer needs
4.8	*power requirements*:	approximately 10 W
4.9	*servicing interval*:	every six months a service check
4.10	*other characteristics*:	

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*:	US$ 500 to US$ 1,000

7. *Name and adress of person responsible for further information*:

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227 Liberty Plaza
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Telephone: 315-336-0230
Telefax: 315-336-2080
E-mail: doveelec@aol.com
URL: http://

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

- Churnside, J.H., S.G. Hanson, and J.J. Wilson (1995): "Determination of Ocean Wave Spectra from Images of Backscattered Incoherent Light," Appl.Opt. 34(1995)962-968
- Hanson, S.G., J.H. Churnside and J.J. Wilson (1994): "Remote Sensing of Wind Velocity and Strength of Refractive Turbulence using a Two-Spatial Filter Receiver," Appl. Opt. 33(1994)5859-5868

Identification number: **1.1.5.5.** [094]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Micro HOLODAR@ Model 600 measures atmospheric turbulence and wind parameters (i.e., wind shear).
2. *State of development*: Working prototype
3. *Principle of operation*: Measures crosswinds and atmospheric turbulence. Features small size, ease of transport and set-up and low power requirement (1 W) allowing for on-site field applications (building airflow, sports, military applications, snow barrier design)

Main technical characteristics

4.1	*application*:	measuring wind speed, wind direction and turbulence
4.2	*measuring range*:	to 1 km
4.3	*uncertainty*:	5 to 10%
4.4	*time constant*:	
4.5	*averaging time*:	30 s
4.6	*reliability*:	highly reliable, no moving parts
4.7	*interface and output details*:	to be determined bv customer needs
4.8	*power requirements*:	1 W
4.9	*servicing interval*:	every six months a service check
4.10	*other characteristics*:	

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*:	US$ 500

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Churnside, J.H., S.G. Hanson, and J.J. Wilson (1995): "Determination of Ocean Wave Spectra from Images of Backscattered Incoherent Light," Appl.Opt. 34(1995)962-968
- Hanson, S.G., J.H. Churnside and J.J. Wilson (1994): "Remote Sensing of Wind Velocity and Strength of Refractive Turbulence using a Two-Spatial Filter Receiver," Appl. Opt. 33(1994)5859-5868

Identification number: **1.1.5.6.** [095]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Passive HOLODAR® Model 500 remotely measures atmospheric turbulence and wind parameters along a single path using a stable or fixed location.
2. *State of development*: Working prototype
3. *Principle of operation*: Measures crosswinds and atmospheric turbulence (atmospheric, pollution tracking, weapons systems, etc.) and fluid flows without the use of an active transmission device. It makes use of wavelet transforms, neural networks, advanced optics and digital imaging technologies

Main technical characteristics

4.1	*application*:	measuring wind speed, wind direction and turbulence
4.2	*measuring range*:	1 km
4.3	*uncertainty*:	10%
4.4	*time constant*:	
4.5	*averaging time*:	30 s
4.6	*reliability*:	highly reliable, no moving parts
4.7	*interface and output details*:	to be determined by customer needs
4.8	*power requirements*:	10W
4.9	*servicing interval*:	every six months a service check
4.10	*other characteristics*:	

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*:	US$ 1,000

7. *Name and adress of person responsible for further information*:

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URL: http://

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

- Churnside, J.H., S.G. Hanson, and J.J. Wilson (1995): "Determination of Ocean Wave Spectra from Images of Backscattered Incoherent Light," Appl.Opt. 34(1995)962-968
- Hanson, S.G., J.H. Churnside and J.J. Wilson (1994): "Remote Sensing of Wind Velocity and Strength of Refractive Turbulence using a Two-Spatial Filter Receiver," Appl. Opt. 33(1994)5859-5868

Identification number: **1.1.5.7.** [096]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Active Wind Alert Model 400 remotely measures atmospheric turbulence and wind parameters along a single path using a stable or fixed location.
2. *State of development*: Working prototype
3. *Principle of operation*: Provides wind alert or high wind warning to drivers on highways, bridges, hills, mountains, valleys, canyons and other high wind or snow areas. Uses light emitting diodes instead of lasers

Main technical characteristics

4.1	*application*:	measuring wind speed, wind direction and turbulence
4.2	*measuring range*:	100 m
4.3	*uncertainty*:	10%
4.4	*time constant*:	
4.5	*averaging time*:	30 s
4.6	*reliability*:	highly reliable, no moving parts
4.7	*interface and output details*:	to he determined by customer needs
4.8	*power requirements*:	2 W
4.9	*servicing interval*:	every six months a service check
4.10	*other characteristics*:	

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*:	US$ 200

7. *Name and adress of person responsible for further information*:

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E-mail: doveelec@aol.com
URL: http://

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

- Churnside, J.H., S.G. Hanson, and J.J. Wilson (1995): "Determination of Ocean Wave Spectra from Images of Backscattered Incoherent Light," Appl.Opt. 34(1995)962-968
- Hanson, S.G., J.H. Churnside and J.J. Wilson (1994): "Remote Sensing of Wind Velocity and Strength of Refractive Turbulence using a Two-Spatial Filter Receiver," Appl. Opt. 33(1994)5859-5868

Identification number: **1.1.5.8.** [101]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Ultrasonic type anemometer that uses a magnetometer for north reference and a microprocessor for extensive data processing internal to the sensor
2. *State of development*: Definition of design 90% completed. Fabrication of prototype instrument 10% completed. Testing of component systems 80% completed.
3. *Principle of operation*: A three axis ultrasonic anemometer bas been modified so that its microprocessor can combine the direction reference from an attached magnetometer so that wind direction is correctly reported even when the instrument is pitching, rolling, and yawing wren mounted on a buoy.

Main technical characteristics

4.1	*application*:	Wind measurement on buoys at sea
4.2	*measuring range*:	0 to 80 m (s/speed) 0 to 360° (direction)
4.3	*uncertainty*:	± 5% of reading
4.4	*time constant*:	not determined
4.5	*averaging time*:	variable (as needed) ¼ second to 10 minutes
4.6	*reliability*:	90%
4.7	*interface and output details*:	digital output (rs485) of instantaneous measurement and of processed data consisting of averaged and peak wind values
4.8	*power requirements*:	9 to 30 VDC, 90 mA
4.9	*servicing interval*:	3 years

4.10 *other characteristics*:
Internal microprocessor used to control the operation of the ultrasonic transducers, make time of travel (sound pulse) measurements, make trigonometric and matric transformations, format data output, average the instantaneous 3 axis wind measurement, etc.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Very good comparison with collocated wind sensors of the propeller-vane type (r.M. Young wind monitor

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	us$ 300

7. *Name and adress of person responsible for further information*:

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Telefax: 601-688-3153
E-mail: rdagnall@ndbc.noaa.gov
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Gill instruments ltd, uk: wind master ultrasonic anemometer manual

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Identification number: **1.1.5.9.** [149]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Multichannel Averaging Wind Display for aviation
2. *State of development*: Prototype passed
3. *Principle of operation*: Multichannel averaging wind display for heavy duty use e.g. aviation - wind speed, gusts and direction w. variance, cross/tail wind components, configurable site id. High intensity LED technology w. automatic brightness control. On-line configurable. Serial i/o for sensors and transmitters. Slim line, mountable on desk, wall, ceiling or panel.

Main technical characteristics

4.1 *application*: Aviation
4.2 *measuring range*: any
4.3 *uncertainty*: sensor/transmitter dependent
4.4 *time constant*:
4.5 *averaging time*: configurable
4.6 *reliability*:
4.7 *interface and output details*: serial i/o
4.8 *power requirements*: 10 to 30 VDC
4.9 *servicing interval*:
4.10 *other characteristics*:
Heavy duty multichannel averaging wind display for aviation use

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 adress of person responsible for further information*:

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URL: http://www.vaisala.com

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

Identification number: **1.1.5.10.** [150]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Digital Wind/TU transmitter
2. *State of development*: Design
3. *Principle of operation*: Digital wind, temperature and humidity transmitter with flexible communication support.

Main technical characteristics

4.1	*application*:	Wind and T/U-measurements in meteorology
4.2	*measuring range*:	sensors dependent
4.3	*uncertainty*:	sensor/transmitter dependent; signals are digitized at site
4.4	*time constant*:	
4.5	*averaging time*:	not specified
4.6	*reliability*:	
4.7	*interface and output details*:	serial i/o
4.8	*power requirements*:	not specified
4.9	*servicing interval*:	
4.10	*other characteristics*:	

Heavy duty digital transmitter with wide operating temperature 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*:	

7. *Name and adress of person responsible for further information*:

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

Identification number: **1.1.5.11.** [151]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Multichannel Averaging Wind, Temperature and Humidity Display
2. *State of development*: Design
3. *Principle of operation*: Multichannel averaging WTU display - wind speed and direction, temperature and humidity. High intensity LED technology w. automatic brightness control. On-line configurable. Digital, analog and serial i/o for sensors and transmitters. Slim line, mountable on desk, wall, ceiling or panel.

Main technical characteristics

4.1	*application*:	Emergency Response
4.2	*measuring range*:	sensor/transmitter dependent
4.3	*uncertainty*:	sensor/transmitter dependent
4.4	*time constant*:	
4.5	*averaging time*:	not specified
4.6	*reliability*:	
4.7	*interface and output details*:	digital, analog and serial i/o
4.8	*power requirements*:	10.5 to 15.5 VDC
4.9	*servicing interval*:	
4.10	*other characteristics*:	

General purpose averaging wind display with temperature and humidity readings for multiple site applications

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 adress of person responsible for further information*:

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URL:	http://www.vaisala.com

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

Identification number: **1.1.5.12.** [152]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Combined Wind Sensor for low power applications.
2. *State of development*: Design
3. *Principle of operation*: Cup wheel and vane are integrated to one unit. Passive signals; potentiometer w. cap or no cap for wind direction and switch for wind speed. For very low power applications.

Main technical characteristics

4.1	*application*:	Horizontal surface wind measurement
4.2	*measuring range*:	speed 0.5 to 60 m/s, direction 0 to 360°
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	analog (passive)
4.8	*power requirements*:	very low
4.9	*servicing interval*:	check once in a year
4.10	*other characteristics*:	

Low power, low price combined wind sensor

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 adress of person responsible for further information*:

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E-mail: tapani.tiusanen@vaisala.com
URL: http://www.vaisala.com

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

Other entries related to this category:

1.1.02.2	2.1.02.23
1.1.02.4	2.1.02.24
1.2.04.2	2.1.02.25
1.3.00.6	2.1.02.26
2.1.02.7	2.1.02.27
2.1.02.11	2.1.02.28
2.1.02.12	2.1.02.29
2.1.02.13	2.1.02.30
2.1.02.14	2.2.01.2
2.1.02.15	2.2.01.3
2.1.02.17	2.2.04.1
2.1.02.22	

1.1.6. Measurement of precipitation

Identification number: **1.1.6.1.** [063]
Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Acoustic Precipitation Detector
2. *State of development*: Initial design for feasibility
3. *Principle of operation*: Detection of precipitation type using acoustic signature on rigid or water surface

Main technical characteristics

4.1 *application*: Use at automatic weather 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*:
4.9 *servicing interval*:
4.10 *other characteristics*:
A low cost sensor to complement other precipitation detectors

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 adress of person responsible for further information*:

Mr David Hatton
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URL: http://www.meto.gov.uk

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

Identification number: **1.1.6.2.** [064]
Country: **United Kingdom of Great Britain and Northern Ireland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Remote Video Camera Observing System
2. *State of development*: Feasibility study complete, initial trials underway
3. *Principle of operation*: Commercial surveillance camera + image compression & transmission technology using frequently updated still images transmitted over landlines (ISDN, PSTN, etc.)

Main technical characteristics

4.1 *application*: Monitor weather + enhance automated measurements.
4.2 *measuring range*: Visible light at present
4.3 *uncertainty*:
4.4 *time constant*: 1 to 5 s update
4.5 *averaging time*: Instantaneous
4.6 *reliability*:
4.7 *interface and output details*: Data adaptor + modem over ISDN/PSTN
4.8 *power requirements*:
4.9 *servicing interval*:
4.10 *other characteristics*:
Cameras have remote control for pan, tilt, zoom, focus, iris aperture. Daylight operation initially - use of artificial lighting and low light cameras being developed. manual interpretation of images initially - automatic analysis of images being developed

Experiences and other information

5. *Experience from comparisons and tests performed*:
Internal feasibility study completed

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

7. *Name and adress of person responsible for further information*:

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URL: http://www.meto.gov.uk

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

Identification number: **1.1.6.3.** [092]
Country: **Pakistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Plastic coating of raingauge
2. *State of development*: In test
3. *Principle of operation*: See 4.10 (Other characteristics)

Main technical characteristics

4.1 *application*: Precipitation measurements
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*: N/A
4.9 *servicing interval*: N/A
4.10 *other characteristics*:
Due to Plastic coating the raingauge bottle (receiver) will be protected from rusting (due to weather conditions) and will have long live.

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 adress of person responsible for further information*:

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Headquarters Office
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Telefax: (92-21) 8112885/8112887
E-mail: pmd@paknet3.ptc.pk
URL: http://

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

Identification number: **1.1.6.4.** [201]
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*: Commercialized with Andrew Antenna Canada Ltd. Technology upgrade for Front-End Processor under review. Additional signal processing and software being considered to report accumulated precipitation and more complete present weather reports. Drop size distribution under consideration.
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.

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 min
4.5 *averaging time*: 1 min
4.6 *reliability*:
4.7 *interface and output details*: Digital output from a front-end processor. Designed to operate with an automatic weather station.
4.8 *power requirements*: 110 VAC
4.9 *servicing interval*: Approximately 1 year
4.10 *other characteristics*:
Designed to operate in the diverse Canadian Climate with our AWOS (Automatic Weather Observing System) also known as READAC (Remote Environmental Automatic Data Acquisition Concept).

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 adress of person responsible for further information*:

Earle Robinson
Atmospheric Environment Service,
Environment Canada
4905 Dufferin St.
Downsview, Ont.
M3H 5T4
Canada

Telephone: 416-739-4586
Telefax: 416-739-4261
E-mail: Earle.Robinson@ec.gc.ca
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Being manufactured by Andrew Canada Inc., Fax #: 905-668-8590

Other entries related to this category:

1.1.02.2	2.1.02.13	2.1.02.24	2.1.02.29
1.1.02.4	2.1.02.15	2.1.02.25	2.1.02.30
1.1.05.1	2.1.02.17	2.1.02.26	2.1.13.2
1.3.00.6	2.1.02.22	2.1.02.27	2.3.00.4
2.1.02.11	2.1.02.23	2.1.02.28	

1.1.7. Measurement of radiation

Identification number: **1.1.7.1.** [006]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The sunshine sensor (SS) GF-1 determines the periods of time in which the difference between total and diffuse radiation exceed a given value.
2. *State of development*: Experimental prototype
3. *Principle of operation*: The instrument produces a logical "yes" signal when the difference between the open and shaded pyranometers' signal exceeds 100 - 120 W/m^2

Main technical characteristics

4.1	*application*:	Actionometry at automatic stations
4.2	*measuring range*:	Illumination 50 - 200 W/m^2
4.3	*uncertainty*:	±5% about he threshold in the temperature range
4.4	*time constant*:	nil
4.5	*averaging time*:	nil
4.6	*reliability*:	10,000 hours
4.7	*interface and output details*:	Output signal in TTL standard
4.8	*power requirements*:	38 ± 2 V DC
4.9	*servicing interval*:	1 year
4.10	*other characteristics*:	

Operating temperature range: -40 to +55 °C

Experiences and other information

5. *Experience from comparisons and tests performed*:
Satisfactory compatibility of results with parallel observations using the Campbell-Stokes instrument.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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4, Kh. Asomov Street
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Uzbekistan

Telephone: 34 93 61
Telefax: 34 74 89
E-mail:
URL: http://

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

Identification number: **1.1.7.2.** [002]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The PPL-1 type pyranometer measures global and diffuse solar radiation and outputs the results on line and on a digital screen
2. *State of development*: Experimental prototype
3. *Principle of operation*: The film semiconductor thermopile converts the radiation energy into electromotive force, which is amplified and converted into a pulse frequency.

Main technical characteristics

4.1	*application*:	Actionometry and meteorology
4.2	*measuring range*:	40 to 1,500 W/m^2
4.3	*uncertainty*:	≤3%
4.4	*time constant*:	≤2 s
4.5	*averaging time*:	1 s
4.6	*reliability*:	10,000 hours
4.7	*interface and output details*:	Digital readout at the measurement site, in binary code in TTL standard via communication line
4.8	*power requirements*:	38±2 V DC
4.9	*servicing interval*:	1 year

4.10 *other characteristics*:
Operating temperature range: -40 to 55 °C
Weight: ≤10 kg
Additional error from temperature measurement: ≤3%
Stability of characteristics over 1 year: ≤2%

Experiences and other information

5. *Experience from comparisons and tests performed*:
Parallel observations with the prototype actinometer have confirmed the basic error and time constant values

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

7. *Name and adress of person responsible for further information*:

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Telefax: 34 74 89
E-mail:
URL: http://

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

Identification number: **1.1.7.3.** [005]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The APL-1 type actinometer measures direct solar radiation and outputs the results on line and on a digital screen.
2. *State of development*: Experimental prototype
3. *Principle of operation*: The film semiconductor thermopile converts the radiation energy into electromotive force, which is amplified and converted into a pulse frequency

Main technical characteristics

4.1	*application*:	Actinometry and meteorology
4.2	*measuring range*:	40 to 1,100 W/m^2
4.3	*uncertainty*:	≤3%
4.4	*time constant*:	≤2 s
4.5	*averaging time*:	1 s
4.6	*reliability*:	10,000 hours
4.7	*interface and output details*:	Digital readout at the measurement site, binary code in TTL standard via communication line
4.8	*power requirements*:	38±2 V DC
4.9	*servicing interval*:	1 year

4.10 *other characteristics*:
Operating temperature range: -40 to +50°C
Weight: ≤10 kg
Additional error from temperature measurement: ≤3%
Stability of characteristics over 1 year: No worse than 2%

Experiences and other information

5. *Experience from comparisons and tests performed*:
Annual full-scale tests have confirmed the stability of the instrument's parameters.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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E-mail:
URL: http://

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

Identification number: **1.1.7.4.** [034]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* TIR: Total Infrared Radiometer (Pyrgeometer) - low cost field instrument to measure total downwelling infrared radiation 3.5 to 50+ μm
2. *State of development*: First prototypes to be tested in late 1997
3. *Principle of operation*: Measures downwelling infrared radiation by sensing instrument temperature and temperature difference on miniature blackened thermopile. Ventilated fore optic of silicon dome with absorption type solar filter applied to inside. Improved thermal design reduces dome heating and provides more accurate dome error compensation. Improved manufacturing technology used in solar filter reduces variation from instrument to instrument.

Main technical characteristics

4.1	*application*:	Field installations to measure total down welling IR.
4.2	*measuring range*:	3.5 to 50+ μm; field of view ±80°
4.3	*uncertainty*:	Less than ±8 W/m^2
4.4	*time constant*:	< 5 sec
4.5	*averaging time*:	N/A: Depends on data acquisition protocol
4.6	*reliability*:	Designed for long term unattended operation
4.7	*interface and output details*:	Low impedance, high level analog, amplified thermopile and thermistor outputs.
4.8	*power requirements*:	±12 V @ 100 mA; optional ventilator fan, 12V @ 500 mA (startup), < 200 mA (running)
4.9	*servicing interval*:	Annual calibration

4.10 *other characteristics*:
This instrument is designed to reduce errors in current pyrgeometers, including those introduced by heating of the dome, variation of the dome's spectral response, and improper calibration while still being a rugged, field ready instrument It will include a high accuracy, high gain amplifier to reduce errors in amplification.

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*:	US$ 495 (annual calibration)

7. *Name and adress of person responsible for further information*:

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URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
N/A (pending)

Identification number: **1.1.7.5.** [035]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* 4, 6, 0: designed for network operation, improved calibration and documentation; AIRS Automated Infrared Shadowdisk Radiometer - high accuracy field instrument to measure total diffuse downwelling *atmospheric* (shaded optic) infrared radiation 3.0 to 100+ µm
2. *State of development*: First prototypes running 1997
3. *Principle of operation*: Sensor head is located above a convex mirror that views the sky. Scene switching mirror alternates view of primary and secondary detectors between primary mirror (sky) and reference black body. Secondary detector detects 1-3 µm radiation to correct signal of broad band primary detector. Primary mirror is shaded by shadow disk to prevent sun's radiation from reaching the detectors. Micro computer controls shadow disk, scene mirror, and sampling.

Main technical characteristics

4.1	*application*:	Field/laboratory installations to measure total down welling IR.
4.2	*measuring range*:	3.0 to 50+ µm; field of view ±90°
4.3	*uncertainty*:	Less than ±3 W/m^2 over IR spectrum
4.4	*time constant*:	< 5 sec
4.5	*averaging time*:	N/A
4.6	*reliability*:	Designed for long term, unattended operation
4.7	*interface and output details*:	Based on YESDAS-2, has RS-232 serial port for communication with modem or local PC/Mac/UNIX workstation.
4.8	*power requirements*:	±12 V @ 200 mA max; optional ventilator fan, 12V @ 500 mA (startup), < 200 mA (running)
4.9	*servicing interval*:	Clean instrument monthly, annual calibration

4.10 *other characteristics*:
This instrument is a new approach to pyrgeometry and is designed to be the most accurate pyrgeometer available. It eliminates the silicon dome/solar filter and shades the detectors to prevent direct solar radiation from contaminating the measurement of atmospheric radiation.

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*:	US$ $1,995

7. *Name and adress of person responsible for further information*:

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

Identification number: **1.1.7.6.** [037]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* SkyCAM (monochrome) and SkyCAM/C (color) are convenient and reliable field systems for sky imaging.
2. *State of development*: Several prototypes are currently installed at remote field sites within the DOE's ARM program. Product release is planned for early 1998.
3. *Principle of operation*: The SkyCAM is a lower cost "upward looking" monochrome imager while the SkyCAM/C is a "downward looking" color imager. On the color version images of the sky are captured via a heated, inverse imaging mirror and a solid state camera. Both versions maintain camera temperature with an analog servo system for long life. Image data is captured periodically and stored as a JPEG format file on a local (laptop) computer. Data is accessed via modern or LAN.

Main technical characteristics

4.1	*application*:	Field/laboratory installations capture sky images for cloud cover and sky condition determination.
4.2	*measuring range*:	640x480, 320x240, 160x120 color/BW
4.3	*uncertainty*:	< 10% cloud cover under 90% of sky conditions
4.4	*time constant*:	Sample rate variable from one image/sec to one image/day
4.5	*averaging time*:	Programmable, typically one image per minute
4.6	*reliability*:	Designed for long term field use, heated and weatherproof system
4.7	*interface and output details*:	Serial communication via modem or ethernet; PCMIA memory card
4.8	*power requirements*:	+12 VDC, 2 A max, 1 A typical, *plus power to run PC.*
4.9	*servicing interval*:	Clean mirror once a month
4.10	*other characteristics*:	

Fully autonomous, requires PC-laptop computer

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*:	US$ 200

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
N/A (pending)

Identification number: **1.1.7.7.** [042]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* TSP-700 Total solar pyranometer -instrument to measure total solar irradiance on the ground or from aircraft, Model TSP-700 (ground), TSP-700A (aircraft)
2. *State of development*:
3. *Principle of operation*: Uses platinum resistance thermometers (PRTS) to measure the temperature difference between a black body surface and a shielded thermal reference. A ventilator and optional heater ensure stable and reliable operation in all environments.

Main technical characteristics

4.1	*application*:	Meteorological and climatological measurements, global warming and surface albedo studies, management of energy systems, including the evaluation of solar energy systems and control of HVAC systems, remote-sensing ground truth experiments
4.2	*measuring range*:	0.3 to 3 µm (300 - 3000 nm)
4.3	*uncertainty*:	< 1%
4.4	*time constant*:	1.0 s
4.5	*averaging time*:	1 s (when used with YESDAS-2 datalogger)
4.6	*reliability*:	Designed for long-term unattended field and aircraft applications
4.7	*interface and output details*:	0 to 4 VDC, low impedance singled-ended output; prewired with 10m Belden cable
4.8	*power requirements*:	+12 V @ up to 1 A, depending on heater configuration
4.9	*servicing interval*:	Annual calibration
4.10	*other characteristics*:	

Excellent and repeatable cosine response from instrument to instrument.

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*:	US$ 395

7. *Name and adress of person responsible for further information*:

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URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
Beaubien, D. J., A. Bisberg, and A.F. Beaubien (1997): "Investigations in pyranometry." (Accepted for publication in Journal of Atmospheric and Oceanic Technology).

Identification number: **1.1.7.8.** [090]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* SCAPP = Scanning Pyrheliometer-Pyranometer. Modification of sunshine recorder SONIe to measure additionally direct solar radiation and - as weighted integral of sky sectors - diffuse solar radiation.
2. *State of development*: Last step of prototype development. Final improvement of cosine errors, modemization of data taking of a prototype (pre-prototype described in 8.)
3. *Principle of operation*: Continuously rotating head with a small sectorial slit (3° FOV at the horizon) allows the detection of the sky irradiance in small sectors (between zenith and horizon) and the separation of sun's peak, if sun is shining. The amplified data are mathematically transformed to hemispherical solar radiation, direct solar radiation (cosine error corrected) and global solar radiation. The calibration is performed by comparison with substandard pyranometers and pyrheliometers.

Main technical characteristics

4.1	*application*:	As second class radiometers **(ISO** 9060) and for sunshine duration measurement.
4.2	*measuring range*:	0 to 1200 W/m² (radiometric); 0 to 24 h
4.3	*uncertainty*:	see ISO 9060
4.4	*time constant*:	< 1 ms (silicon detector)
4.5	*averaging time*:	radiometric: 1 min; sunshine duration resolution: 1 s
4.6	*reliability*:	not yet known for longer periods
4.7	*interface and output details*:	RS232; 10 V max; pre-amplifier in detector
4.8	*power requirements*:	220 VAC; 50 Hz, 40 W (without computer)
4.9	*servicing interval*:	depending on environmental dust (dome cleaning)
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 adress of person responsible for further information*:

Dr Klaus Dehne
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Postfach 600 552
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Telefax: 0049 331 316-591
E-mail: dehne@mop.dwd.d400.de
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Bergholter, U. and K. Dehne (1994): "SCAPP, a compact scanning pyrheliometer-pyranometer system for direct, diffuse and global solar radiation", in: WMO-IOM-Report No. 57: Papers presented at the TECO-94, Geneva, Switzerland (28 Febr. - 2 March 1994)

Identification number: **1.1.7.9.** [194]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Multi-filter UV Spectroradiometer (type MS-132) produces precise UV spectra and determines subsequently total column ozone.
2. *State of development*:
3. *Principle of operation*: A wheel with 6 interference filters rotates at a constant speed. A high-resolution UV spectrum is derived by simple algebraic computation using outputs through each filter. The ratio of spectral intensity at specified wavelengths is used to determine total column ozone.

Main technical characteristics

4.1	*application*:	Measurement of global UV spectrum and total column ozone.
4.2	*measuring range*:	300 to 400 nm
4.3	*uncertainty*:	±5%
4.4	*time constant*:	< 1 s
4.5	*averaging time*:	5 min
4.6	*reliability*:	N/A
4.7	*interface and output details*:	Signals are sent to PC through RS-232C. Final outputs are column ozone, UV spectrum, UV-B and A.
4.8	*power requirements*:	100/200 VAC, 15 W
4.9	*servicing interval*:	Wipe clean surface of diffuser once a week.
4.10	*other characteristics*:	

Temperature dependency and zero drift is automatically compensated within ±1% from -20 to 40°C employing the installed software. The calibration is carried out comparing with a precise spectroradiometer being traceable to standard spectral irradiance of National Institute of Standards and Technology (NIST).

Experiences and other information

5. *Experience from comparisons and tests performed*:
The spectra produced by this method bas been compared with that measured by a precise spectroradiometer under various conditions.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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Telefax: 81-3-5352-2917
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URL: http://

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

Other entries related to this category:

1.1.02.2	2.1.02.23	2.1.02.29
1.1.02.4	2.1.02.24	2.1.02.30
1.2.03.1	2.1.02.25	2.1.05.12
2.1.02.11	2.1.02.26	2.1.15.3
2.1.02.14	2.1.02.27	2.2.01.7
2.1.02.22	2.1.02.28	2.2.01.8

1.1.8. Measurement of sunshine duration

Identification number: **1.1.8.1.** [008]
Country: **Slovakia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sunshine duration recorder DB-SS8
2. *State of development*: The last stage of development; to be operational in 1997
3. *Principle of operation*: The silicon cell arrays is used to measure global and diffuse solar radiation. If calculated direct solar irradiance exceeds the threshold value of 120 W/m^2, the sunshine is recorded and data are stored in the memory

Main technical characteristics

4.1	*application*:	Replacement of Campbell-Stokes sunshine recorder.
4.2	*measuring range*:	Adjustable 50 - 220 W/m^2
4.3	*uncertainty*:	±5% FS
4.4	*time constant*:	1 s
4.5	*averaging time*:	36 s
4.6	*reliability*:	High. No moving parts
4.7	*interface and output details*:	Digital output YES - NO sunshine. Memory for 2 years of operation (hourly, daily sums).
4.8	*power requirements*:	Battery 4 V. Optional thermostated heater 24 V AC, 35 W
4.9	*servicing interval*:	Up to one year
4.10	*other characteristics*:	

- No moving parts,
- Battery life for at last 1 year
- Temperature compensated sensors
- Additional errors caused by changing height of the noontime sun during the year are corrected
- Detector inclination angle 0 - 90°
- Option for heating controlled by thermostat
- Digital output for external data logger
- Hourly and daily sums of sunshine duration from internal memory are available to the user
- Simple installation, operation and maintenance

Experiences and other information

5. *Experience from comparisons and tests performed*:
Monthly sums of sunshine duration deviation from the reference within ±5%. Better then by Campbell-Stokes sunshine recorder.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 10,- (battery)

7. *Name and adress of person responsible for further information*:

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Slovakia

Telephone: +0421 7 783 011
Telefax: +0421 7 783 011
E-mail:
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Klaus Dehne, WMO Automatic Sunshine Duration Measurement Comparison (Hamburg 1988/1989)

Other entries related to this category:

1.1.07.6	1.1.07.8	2.1.07.3	2.1.07.8
1.1.07.7	2.1.07.2	2.1.07.7	

1.1.9. Measurement of visibility

- none -

Other entries related to this category:
1.1.02.4
1.1.07.6
2.1.02.15
2.1.02.17
2.1.06.6
2.1.06.7
2.1.07.2
2.1.07.3

1.1.10. Measurement of evaporation

Identification number: **1.1.10.1.** [098]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Pollen & Air Quality
2. *State of development*: Preliminary
3. *Principle of operation*:

Main technical characteristics

4.1	*application*:	Water conservation, environmental
4.2	*measuring range*:	Full (WMO) spectrum
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	Weighted as per WMO
4.6	*reliability*:	>99%
4.7	*interface and output details*:	RS232/485; support phone modem, cellular modem & RF modem, Fiber optic Modem.
4.8	*power requirements*:	110/220 V
4.9	*servicing interval*:	6 months

4.10 *other characteristics*:
- Capacity: 2 weeks of raw data
- Sampling rate: 0.8 s minimum as high as 10×/min on wired
- Storage: Hourly information 2 weeks
- Data transmission: RS232/485 - direct wired or phone communications
- Communications: Modem, Cellular modem, RF.
- Output format: Proprietary
- Met. variables: Wind speed & direction, temperature, RH, rain, Barometric, solar radiation
- Calculated: Dewpoint, Degree Days (2), Evapotranspiration (5), Wet bulb, Rain 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$ 450

7. *Name and adress of person responsible for further information*:

Mr Peter Levy
Weather Metrics, Inc.
14645 W. 95th
Lenexa, KS 66215
USA

Telephone: 913-438-7666
Telefax: 913-438-2666
E-mail: 73422.203@compuserve.com
URL: http://

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

Other entries related to this category:
1.1.02.2
1.1.04.1
2.1.14.2
2.2.01.7

1.1.11. Measurement of soil moisture

- none -

Other entries related to this category:
1.1.04.1

1.1.12. Measurement of upper air pressure, temperature, humidity

Identification number: **1.1.12.1.** [072]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* A new type of digitalized radiosonde, measures temperature, air pressure and humidity, and upper wind as well
2. *State of development*: Some prototypes have been made, and tested well
3. *Principle of operation*: Sensors include: Temperature-1, rod thermistor; temperature-2, bead thermistor, for temperature compensation of pressure sensor; humidity, high polymer hygristor; pressure, capacitive aneroid capsule, or silicon semiconductor.
Signals from sensor convert through R/V or C/V (silicon pressure through an amplifier) to multiplexer, then to A/D converter, to which a reference voltage is added. A microprocessor processes and controls the digital data stream to transmitter. A subcarrier oscillator is used for upper wind measurement.

Main technical characteristics

4.1	*application*:	Upper-air sounding, compatible with radar or radiotheodolite of 403 MHz, 1680 MHz or 1782 MHz
4.2	*measuring range*:	Temperature: -90 to +50°C, humidity: 0 to 100%RH, pressure: 10 to 1050 hPa
4.3	*uncertainty*:	Temperature: ±0.3°C (RMS), humidity: ±5%RH (for 300 hPa and lower), ±7%RH (for 300 hPa and higher), pressure: ±2 hPa (for 500 hPa and lower), ±1 hPa (for 500 hPa and higher)
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	Good
4.7	*interface and output details*:	Power output: ≥ 400 mW. Data Format: Asynchronous serial. Data transmission rate: 1200 or 600 baud
4.8	*power requirements*:	Magnesium-Vuprous Chloride Battery
4.9	*servicing interval*:	No need for re-calibration within one and a half year

4.10 *other characteristics*:
- Radio frequency: 403 MHz, 1680 MHz, 1782 MHz, frequency stability: ±3 MHz. Subcarrier frequency can be chosen.
- Modulation: FM or AM, antenna polarization: Vertical
- Sampling rate: 1 s per frame
- Data frame: 21 bytes total, including radiosonde serial number, TPU, temperature for pressure sensor, and reference voltage and with parity check.
- Sensor calibration data: Storage on a floppy-disk
- Weight: ≤ 400 g

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 adress of person responsible for further information*:

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No. 220, Lane 431, Meishou Road
Shanghai 200090
P.R. China

Telephone: (021) 65439104
Telefax:
E-mail:
URL: http://

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

Identification number: **1.1.12.2.** [110]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Microelectrical aerological radiothedolite MARL-2 with radiosonde RF-95 for upper air sounding
2. *State of development*: Ready for put into operational use
3. *Principle of operation*: Radiotheodolite method of sounding with pressure, humidity radiosonde. The measurements of angles by using active phase array.

Main technical characteristics

4.1	*application*:	Upper air sounding
4.2	*measuring range*:	Range: 0 to 250 km, altitude: 0 to 40 km
4.3	*uncertainty*:	Angles 0.05°
4.4	*time constant*:	< 1.5 s
4.5	*averaging time*:	1.5 s
4.6	*reliability*:	10 years
4.7	*interface and output details*:	RS232 or modem
4.8	*power requirements*:	300 W
4.9	*servicing interval*:	10 years
4.10	*other characteristics*:	

Working temperature -55°C to +65°C

Experiences and other information

5. *Experience from comparisons and tests performed*:
MARL-T gives the mean angles errors 0.1 deg. in comparison with AVK-1

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	700 radiosondes, Costs: US$ 7,000

7. *Name and adress of person responsible for further information*:

Dr Alexei Ivanov
Central Aerological Observatory
Pervomayskay 3
Dolgoprudny
Moscow Region
Russian Federation

Telephone:	(7)(095) 408-7685
Telefax:	(7)(095) 576-3327
E-mail:	
URL:	http://

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

Identification number: **1.1.12.3.** [134]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* RS90 family of radiosondes for measurement of upper air profiles of pressure, temperature, humidity and winds. RS90 sondes are with 400 MHz or 1680 MHz transmitter, in either wide or narrow bandwidth versions. Several wind measurement alternatives are available, such as GPS, Loran-C, Communications VLF or RDF. Special sensors for radioactivity and ozone measurement can be added.
2. *State of development*: under development; will be commercially available in 1997
3. *Principle of operation*: A radiosonde flies with a hydrogen or helium balloon. The measurements of capacitive temperature, humidity and pressure sensors are transferred by 400 MHz or 1680 MHz transmitter to the dedicated ground receiver and computation system.
NAVAID windfinding methods relay on a VLF radiosonde receiver for Loran-C or Alpha and Communications VLF networks. A GPS radiosonde receiver measures L1 carrier shift frequencies (Doppler´s) of Global Positioning System (GPS) satellites. The third wind finding alternative RDF is passive and based on radiosonde transmission (1680 MHz). A water-activated battery provides power for the radiosonde.

   The optional Vaisala NSS14 radioactivity sensor is interfaced to Vaisala Radiosondes for measuring the atmospheric profile of radioactivity. Radiation is measured with two Geiger-Müller detectors: the other detector is sensitive to γ-radiation, whereas the other measures both γ- and β-radiation.

   An electrochemical concentration cell (ECC) sensor can be interfaced to RS90 radiosondes. For example an ECC-6A sensor, manufactured by Science Pump Corporation, detects ozone on the basis of iodide redox reaction.

Main technical characteristics

4.1	*application*:	Upper air observations
4.2	*measuring range*:	Pressure:1060 hPa to 3 hPa Temperature.+60°C to -90°C Humidity: 0 to 100 %RH Wind: 0 to 180 m/s Radioactivity (dose rate): 0.1 - 60 mR/h (γ-channel), 0.4 - 120 mR/h (β-channel) Ozone: 0 - 30 mPa ozone partial pressure
4.3	*uncertainty*:	T.D.B.
4.4	*time constant*:	T.D.B.
4.5	*averaging time*:	T.D.B.
4.6	*reliability*:	T.D.B.
4.7	*interface and output details*:	N/A
4.8	*power requirements*:	Water-activated 19 V battery
4.9	*servicing interval*:	N/A (Radiosonde is typically used for 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*:	N/A

7. *Name and adress of person responsible for further information*:

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Finland

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Telefax: +358 9 894 9210
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URL: http://www.vaisala.com

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

Other entries related to this category:
1.1.02.4
1.1.04.1

1.1.13. Measurement of upper wind

Identification number: **1.1.13.1.** [128]
Country: **Thailand**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Upper air observing system
2. *State of development*: Computer operation
3. *Principle of operation*: Find out the movable of balloon for observing the wind speed and direction of upper air by computer processing.

Main technical characteristics

4.1	*application*:	Upper air observing
4.2	*measuring range*:	≥ 20 km
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	High performance
4.7	*interface and output details*:	Monitor displayed
4.8	*power requirements*:	220 V 1 phase, 50 Hz
4.9	*servicing interval*:	
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Just offer for tender

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Mr Varesuan Chandraramya
Meteorological Department
4353 Sukhumvit Rd. Bang-Na
Bangkok 10260
Thailand

Telephone: (66-2)3931681
Telefax:
E-mail:
URL: http://

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

Other entries related to this category:

1.1.02.4	2.1.12.4
1.1.05.3	2.3.00.4
1.1.12.1	
1.1.12.2	
1.1.12.3	
2.1.05.10	
2.1.06.3	
2.1.12.2	
2.1.12.3	

1.1.14. present and past weather, state of the ground:

Identification number: **1.1.14.1.** [087]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Ultrasonic sensor, detection of icing, snow, rain, mixed: water/snow, water/ice
2. *State of development*: DWD-study
3. *Principle of operation*: Ultrasonic detection of the ground conditions especially icing

Main technical characteristics

4.1	*application*:	to detect surface conditions
4.2	*measuring range*:	
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	10 min average
4.6	*reliability*:	
4.7	*interface and output details*:	
4.8	*power requirements*:	25 V
4.9	*servicing interval*:	
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Today there is only experience in the detection of icing on aeroplane wings.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Dr Günter Olbrück
Deutscher Wetterdienst, TI 23, Meßsysteme
Postfach 65 01 50
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Telefax: 0049 4060173-102
E-mail: golbrueck@dwd.d400.de
URL: http://

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

Identification number: **1.1.14.2.** [088]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Lightning detector, detection of lightnings up to 10 km
2. *State of development*: prototype
3. *Principle of operation*: Detection of electromagnetic and electrical waves

Main technical characteristics

4.1	*application*:	to identify a shower as a thunderstorm
4.2	*measuring range*:	~ 10 km
4.3	*uncertainty*:	~ 10 %
4.4	*time constant*:	< 1 ms
4.5	*averaging time*:	single value
4.6	*reliability*:	four years
4.7	*interface and output details*:	RS232 (V 24)
4.8	*power requirements*:	10 W
4.9	*servicing interval*:	yearly
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Good results in comparison with observer detections

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Other entries related to this category:

1.1.05.3
1.1.06.2
1.1.10.1
2.1.02.15
2.1.02.17
2.1.06.6
2.1.06.7
2.3.00.4

1.1.15. Observation of clouds

Identification number: **1.1.15.1.** [089]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* laser ceilometer, cloud height and coverage
2. *State of development*: test and evaluation
3. *Principle of operation*: development of algorithms for the processing of laser data.

Main technical characteristics

4.1	*application*:	cloud height and coverage
4.2	*measuring range*:	0 to 40.000 ft
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	30 min
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 adress of person responsible for further information*:

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E-mail: golbrueck@dwd.d400.de
URL: http://

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

Identification number: **1.1.15.2.** [162]
Country: **Ukraine**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Laser cloud height meter
2. *State of development*: Development of an experimental pattern
3. *Principle of operation*: Method of a measurement of a time interval for laser impulse propagation from instrument to cloud and come back

Main technical characteristics

4.1 *application*: Meteorological stations
4.2 *measuring range*: 30 to 1500 m
4.3 *uncertainty*:
4.4 *time constant*:
4.5 *averaging time*: 10 to 60 s
4.6 *reliability*: 5000 hours of work
4.7 *interface and output details*: Interface between instrument and operator desk, RS232, RS486
4.8 *power requirements*:
4.9 *servicing interval*:
4.10 *other characteristics*:
Absolute accuracy of measurement: 10 m, Sizes: 0.9×0.4×0.3 m, Mass: ≤ 40 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*: US$ 24

7. *Name and adress of person responsible for further information*:

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State Committee for Hydrometeorology
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252 601, Kyiv-34
Ukraine

Telephone: +38 (0)44 2287461
Telefax: +38 (0)44 2291888
E-mail:
URL: http://

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

Other entries related to this category:

1.1.02.4 2.3.00.4
1.1.06.2
1.1.07.6
1.1.07.7
1.2.03.1
2.1.02.15
2.1.02.17
2.1.06.3
2.1.07.2
2.1.07.3
2.1.09.6
2.1.09.7

1.2.1. Measurement at automatic meteorological stations

Identification number: **1.2.1.1.** [004]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The SOPI (information collection, processing and transmission) system automates the collection of information from the meteorological instruments at a meteorological station, processes the information in certain ways and transmits the results in the form of SYNOP, DEKADA, or CLIMAT reports to the central organization via the communication lines.
2. *State of development*: Development of working documentation for the experimental prototype.
3. *Principle of operation*: The interrogation system is via a microcontroller. All the interrogated instruments have a unified ±2 V output. the conversion error is ±10 mV. Interrogation is sequential. The status of the 23 sensors is diagnosed.

Main technical characteristics

4.1	*application*:	Automation of data collection, elimination of subjective errors
4.2	*measuring range*:	Output of all sensors is within the range ±2 V
4.3	*uncertainty*:	±10 mV
4.4	*time constant*:	Measuring frequency: 5 s for wind speed and direction; 1 min from temperature from dry- and wet-bulb and over-soil thermometers
4.5	*averaging time*:	For temperature sensors: 40 s
4.6	*reliability*:	5,000 hours
4.7	*interface and output details*:	Converter output: Seven-segment indicator code, microcontroller output: RS232, direct binary code
4.8	*power requirements*:	42 V AC, 2 A
4.9	*servicing interval*:	3 months
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 adress of person responsible for further information*:

Mr Leonid A. Kanaev
NPP Gidrometpribor
4, Kh. Asomov Street
700084 Tashkent
Uzbekistan

Telephone: 34 93 61
Telefax: 34 74 89
E-mail:
URL: http://

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

Identification number: **1.2.1.2.** [085]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* AMIDA III: Measurement of four basic parameters: temperature (2 m, 5 cm), humidity, precipitation, optional parameters: wind s.a.
2. *State of development*: preparation of specification
3. *Principle of operation*: semi-automatic-station with voluntary observers, ISDN-transmission

Main technical characteristics

4.1 *application*: Climatological Network
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*: 230 V, 50Hz
4.9 *servicing interval*:
4.10 *other characteristics*:
- Data acquisition capacity: 4 basic sensors (s. B. 1) and additional
- Station sampling rate: 1 Hz (wind: 4 Hz)
- Local storage: two weeks
- Data transmission: every three hours
- Communication: ISDN-transmission, FTP
- Output format: ASCII, encoded data
- Processing possibilities: quality control; raw signal/data conversion; production of significant meteorological variables
- Environmental conditions: preprocessing outdoors data processing indoors

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 adress of person responsible for further information*:

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E-mail: golbrueck@dwd.d400.de
URL: http://

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

Identification number: **1.2.1.3.** [086]
Country: **Germany**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Measurement of precipitation and additional temperature (1 m)
2. *State of development*: preparation of specification
3. *Principle of operation*: semi-automatic-station with voluntary observers, ISDN-transmission.

Main technical characteristics

4.1 *application*: Precipitation Network
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*: 230 V, 50 Hz
4.9 *servicing interval*:
4.10 *other characteristics*:
- Data acquisition capacity:1 basic sensor, temperature additional
- Station sampling rate: 1 Hz
- Local storage:two weeks
- Data transmission:once per day
- Communication:ISDN-transmission, FTP
- Output format: ASCII, encoded data
- Processing possibilities: quality control; raw signal/data conversion; production of significant meteorological variables
- Environmental conditions: preprocessing outdoors data processing in-/outdoors.

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$ 500

7. *Name and adress of person responsible for further information*:

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Telefax: 0049 4060173-102
E-mail: golbrueck@dwd.d400.de
URL: http://

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

Identification number: **1.2.1.4.** [205]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* AWOS (Automatic Weather Observing System) also known as READAC (Remote Environmental Automatic Data Acquisition Concept) automatic weather station.

2. *State of development*: Evolution strategies being invoked. Includes technology upgrades of modules/components due to changing technology and requirements. New data formats, archiving requirements, communications media, maintenance methods and manufacturing techniques. Leads to AWOS[1991] replacement plans and upward compatible systems.

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

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 s 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 VAC
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*: dependent on sensor complements.

7. *Name and adress of person responsible for further information*:

Earle Robinson
Atmospheric Environment Service,
Environment Canada
4905 Dufferin St.
Downsview, Ontario
M3H 5T4
Canada

Telephone: 416-739-4586
Telefax: 416-739-4261
E-mail: Earle.Robinson@ec.gc.ca
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- "Readac" has been trademarked to the Atmospheric 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

Other entries related to this category:

1.1.02.9	1.1.07.5	2.1.02.16	2.1.08.1
1.1.03.1	1.1.07.6	2.1.02.22	2.1.09.4
1.1.04.2	1.1.07.7	2.1.02.31	2.1.09.8
1.1.04.3	1.1.07.8	2.1.05.8	2.1.15.2
1.1.05.4	1.1.08.1	2.1.06.8	2.1.15.4
1.1.05.5	1.1.10.1	2.1.07.2	2.2.02.3
1.1.05.6	1.2.05.1	2.1.07.3	
1.1.05.7	2.1.02.1	2.1.07.4	
1.1.06.2	2.1.02.5	2.1.07.5	
1.1.07.4	2.1.02.15	2.1.07.6	

1.2.2. Instruments and observations at aeronautical stations

- none -

Other entries related to this category:

1.1.05.3	2.1.05.8	2.2.01.14
1.1.05.4	2.1.06.8	2.2.01.15
1.1.05.5	2.1.07.2	
1.1.05.6	2.1.07.3	
1.1.05.7	2.1.07.7	
1.1.07.4	2.1.09.4	
1.1.07.5	2.1.09.9	
1.1.07.7	2.1.15.2	
2.1.01.3	2.2.01.4	
2.1.02.31	2.2.01.5	

1.2.3. Aircraft observations

Identification number: **1.2.3.1.** [166]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Airborne cloud drop spectrometer measures liquid water content and drop size distribution from 3 - 200 μm diameter.
2. *State of development*: See § 5.
3. *Principle of operation*: Forward scattered light from an ensemble of drops is recorded on a 512 element CCD array. Liquid water content and drop size distribution is computed in real time in software.

Main technical characteristics

4.1 *application*: Cloud physics icing research
4.2 *measuring range*: 3 to 200 μm diameters drops
4.3 *uncertainty*: 12%
4.4 *time constant*: 0.01 s
4.5 *averaging time*: N/A
4.6 *reliability*: Good
4.7 *interface and output details*: Interface to PC computer
4.8 *power requirements*: 2 kW 110V 60 Hz (Includes de-icing)
4.9 *servicing interval*: N/A
4.10 *other characteristics*: The CDS measures forward scattered light from an ensemble of drops. The measurements are made from 0.15° -> 9° using a CCD detector with 512 pixels, producing an angular measurement resolution of 0.017°. The CDS is the first airborne instrument to measure both cloud LWC and drop size distribution from an ensemble of drops. The raw measurements are recorded and LWC is computed in software by assigning appropriate weights to the angular measurements. An inversion algorithm determines the shape of the drop size spectra and LWC is used to compute a linear scale factor which gives absolute number concentrations for each drop size bin. The CDS was operated in a major field project and reliably measured the adiabatic values of LWC from about 0.5 to 2 km above cloud base in undiluted updraft regions in small, warm (T > O°C) Florida cumuli. Also, the CDS was in agreement with measurements of drop size spectra from the FSSP and FFSSP probes.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Airborne comparisons with PMS FSSP, FFSSP and Gerber Scientific PVM-100A show advantages of cloud drop spectrometer.

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

7. *Name and adress of person responsible for further information*:

Dr R. Paul Lawson
SPEC, Incorporated
5401 Western Avenue, Suite B
Boulder, Colorado 80026
USA

Telephone: 303/449-1105
Telefax: 303/449-0132
E-mail: plawson@specinc.com
URL: http://www.specinc.com

8. *Major bibliographic references, applicable patents, etc.:*
- Lawson, R.P. and R.H. Cormack (1995): "Theoretical design and preliminary tests of two new particle spectrometers for cloud microphysics-research.", Atmos. Res. 35(1995)315-348.
- Lawson, R.P. and A.M. Blyth, 1997 : A comparison of optical measurements of liquid water content and drop size distribution in adiabatic regions of Florida cumuli. Accepted for publication in Atmos. Res.

Other entries related to this category:
1.1.04.2
1.1.07.4
1.1.07.7
2.1.04.1
2.1.12.3
2.1.15.3
2.2.01.5

1.2.4. Marine observations

Identification number: **1.2.4.1.** [017]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Reading Information Technology, Inc. (RITI) is trying to develop a "software" that integrates ocean wave height data with GIS technology for marine route planning
2. *State of development*: Routing algorithm undeveloped, GIS and data transfer in alpha
3. *Principle of operation*: For commercial marine industry use. Integrate NOAA ocean wave height forecast data from WWW into GIS based "Expert System" to calculate an optimized navigation route to help vessel captains avoid heavy weather at sea.

Main technical characteristics

4.1	*application*:	on NT platform
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*:	Internet, satellite communications, GPS, GIS, radio modems, transponders, NMEA, S57
4.8	*power requirements*:	Standard shipboard and PC
4.9	*servicing interval*:	N/A
4.10	*other characteristics*:	

N/A

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*:	US$ 4,500 per vessel

7. *Name and adress of person responsible for further information*:

Kevin Meagher
Reading Information Technology, Inc.
274 Main Street
Reading, MA 01867
USA

Telephone: 617-942-1655 X 15
Telefax: 617-942-2162
E-mail: kjm@riti.com
URL: http://www.riti.com

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

Identification number: **1.2.4.2.** [019]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* AN/WSQ-6 Drifting data buoy
2. *State of development*: Within 6 months of completion (febr. 1998)
3. *Principle of operation*: A family of drifting buoys designed to collect various oceanographic and meteorological data and to relay that data to a satellite

Main technical characteristics

4.1	*application*:	Drifting sensor package
4.2	*measuring range*:	Various
4.3	*uncertainty*:	Various
4.4	*time constant*:	Various
4.5	*averaging time*:	Various
4.6	*reliability*:	45 to 90 day life-expendable
4.7	*interface and output details*:	Output to ARGOS satellite
4.8	*power requirements*:	Self contained, non replaceable
4.9	*servicing interval*:	N/A
4.10	*other characteristics*:	
	N/A	

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*:	0 - expendable

7. *Name and adress of person responsible for further information*:

Mr George Dobson
Sparton Electronics
PO Box 788
DeLeon Springs, Florida 32130
USA

Telephone: 904 740 5412
Telefax:
E-mail: gdobson@sparton.com
URL: http://

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

Other entries related to this category:

1.1.05.3
1.1.07.4
1.1.07.5
1.1.07.7
2.1.07.2
2.1.07.3
2.2.01.5
2.2.01.11
2.2.02.1

1.2.5. Special profiling techniques for the boundary layer and the troposphere

Identification number: **1.2.5.1.** [066]
Country: **Sweden**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* GPS/Glonass receivers of highest quality together with data postprocessing -> Integrated precipitable water vapour
2. *State of development*: Initial tests within nationwide networks in the Nordic countries
3. *Principle of operation*: GPS receivers measurers signal travel time between satellite and receiver. Several effects influence this result. Sophisticated software and proper models makes it possible to *estimate* the signal delay due to water vapour and convert to Integrated Precipitable Water Vapour (IPWV)

Main technical characteristics

4.1	*application*:	Integrated Precipitable Water Vapour (IPWV)
4.2	*measuring range*:	(within satellite orbit)
4.3	*uncertainty*:	few %
4.4	*time constant*:	N/A
4.5	*averaging time*:	N/A
4.6	*reliability*:	99%
4.7	*interface and output details*:	RS232 com PC. Dataformat different from different brands
4.8	*power requirements*:	15 W
4.9	*servicing interval*:	1 per year

4.10 *other characteristics*:
GPS receivers are used for navigation and positioning. Many countries in Europe and North America have fairly dense continuously operating networks of receivers. The man purpose is to facilitate accurate positioning but also geophysical investigations. These networks are also starting to be used for climate studies, etc.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparisons with radiosonde balloons, microwave radiometry, SSMS data, and models verify stated uncertainties (tests in Sweden and the BaLTEX project)

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Experience so far: Maintenance approx. nil (retrieving data and processing only done in tests with several stations)

7. *Name and adress of person responsible for further information*:

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Onsala Space Observatory
Chalmers University of Technology
S-439 92 Onsala
Sweden

Telephone: (+46) 31 7725558
Telefax: (+46) 31 7725590
E-mail: jmj@oso.chalmers.se
URL: http://www.oso.chalmers.se

8. *Major bibliographic references, applicable patents, etc.:*
- Bevis, M., S. Businger, R.A. Harring, C. Rocken, R.A. Anthes and R.H. Ware (1992): "GPS Meteorology: Remote Sensing of Atmospheric Water Vapour Using the Global Positioning System", Journal of Geophysical Res. 97[14](1992)15787-15801
- Elgered, Carlsson and Johansson (1996): "Baltic Sea Experiment BALTEX"

Other entries related to this category:
1.1.04.1
2.1.02.7
2.1.06.3
2.1.07.3
2.1.13.3
2.2.01.16

1.2.6. Rocket measurements in the stratosphere and mesosphere

- none -

Other entries related to this category:
[none]

1.2.7. Locating the sources of atmospherics

- none -

Other entries related to this category:
2.1.15.4

1.3. Other

Identification number: **1.3.0.1.** [001]
Country: **Uzbekistan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Pereprava [ferry] complex is designed for automatic determination of stream flow at sections equipped with ferry boats. it can measure stage up to 20m, streamflow up to 3.5 m/s and section width up to 1000m.
2. *State of development*: 1
3. *Principle of operation*: The equipment's microprocessor unit with 1 Hz frequency integrates the speed over the section using an ultrasound depth sonde, a current meter to measure speed and a roller sensor to measure distance from the bank. The algorithm used is in accordance with USSR a.s. 1643933 of 23.IV.1991 (GOIF 1/00).

Main technical characteristics

4.1	*application*:	Hydrology and hydrometry
4.2	*measuring range*:	Depth up to 20 m, flow up to 3.5 m/s and section width up to 1000 m.
4.3	*uncertainty*:	≤ 5%
4.4	*time constant*:	Measurement every second
4.5	*averaging time*:	Time the ferry takes to cross the stream
4.6	*reliability*:	10 000 H
4.7	*interface and output details*:	Information displayed on a digital screen (8 digits)
4.8	*power requirements*:	24 V, 50 Ah storage battery
4.9	*servicing interval*:	1 year
4.10	*other characteristics*:	

Operating temperature range: 0 to +50 °C;
Protected against dust and humidity - Category 1 R 54;
Power: No more than 100 W

Experiences and other information

5. *Experience from comparisons and tests performed*:
Discrepancies between measurements by manual methods and those using the "Pereprava" [crossing] system are no more than 5%

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Mr Leonid A. Kanaev
NPP Gidrometprobor
4, Kh. Asomov street
700084 Tashkent
Uzbekistan

Telephone: 349361
Telefax: 347489
E-mail:
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
USSR a.s. 1643933 of 23.IV.1991, cl. GOIF 1/00

Identification number: **1.3.0.2.** [029]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* This instrument has the name "g-meter". It measures atmospheric optical parameters of aerosols and clouds. These parameters include the asymmetry parameter, extinction coefficient at one wavelength, and the back-scatter to forward ratio.
2. *State of development*: A first prototype is presently under construction; atmospheric tests are scheduled fall 1997.
3. *Principle of operation*: The g-meter measures with 4 photomultipliers light scattered out of a laser beam to obtain g, the asymmetry parameter, optical extinction, and scattering ratio. Lambertian diffusers with cosine baffles placed in front of the detectors result in the desired outputs. Measurements are in-situ and are made for aerosols, cloud droplets, and ice crystals.

Main technical characteristics

4.1	*application*:	Research in aerosol and cloud physics as related to radiation transfer through the atmosphere
4.2	*measuring range*:	Particle size range of sensitivity is from 0.1 to 2000 μm diameter.
4.3	*uncertainty*:	To be determined
4.4	*time constant*:	Adjustable with a minimum of 0.002 s
4.5	*averaging time*:	N/A
4.6	*reliability*:	Unknown
4.7	*interface and output details*:	Four analog voltage outputs (0 to 10 V)
4.8	*power requirements*:	Electronics: 80 W (115 or 220 VAC); heaters: 100 W (28 VDC)
4.9	*servicing interval*:	Unknown
4.10	*other characteristics*:	

The g-meter weights about 25 lbs., and is suitable for ground-based and aircraft measurements.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Tests have demonstrated that the diffuser/baffle arrangement used with the g-meter produces the proper cosine weighed scattering coefficient required for measuring the atmospheric asymmetry parameter of aerosols and particulates.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Nil

7. *Name and adress of person responsible for further information*:

Dr Hermann Gerber
Gerber Scientific Inc.
1643 Bentana Way
Reston, VA 20190
USA

Telephone: 703-742-9844
Telefax: 703-742-3374
E-mail: gerber@access.digex.net
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Gerber, H, 1996: "Measurement of the asymmetry parameter and optical extinction coefficient of ice crystals and water droplets". Final Report, NASA Langley NAS1-20506, pp. 19 (NASA LaRC, Hampton, VA, USA)

Identification number: **1.3.0.3.** [125]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* High accuracy UV-visible Spectroradiometer in environmental enclosure for automated solar measurements in remote sites.
2. *State of development*: a) Final evaluation stage, b) June 1997
3. *Principle of operation*: A scanning double monochromator with PMT measures solar irradiance. It features accurate cosine response, internal reference lamp, Hg Arc lamp, monitor detectors, temperature stabilization, and complete computer control.

Main technical characteristics

4.1	*application*:	UV solar irradiance and Ozone
4.2	*measuring range*:	280 to 600 nm ±0.1 nm
4.3	*uncertainty*:	Irradiance traceable to NIST standard of spectral irradiance
4.4	*time constant*:	10 ms
4.5	*averaging time*:	user controlled
4.6	*reliability*:	Excellent
4.7	*interface and output details*:	Pentiom PC computer with BSI SUV software running under NT. It supports automatic data acquisition and data processing.
4.8	*power requirements*:	120 / 220 VAC
4.9	*servicing interval*:	Annual calibration
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
First operational field tests at "suspen" (Saloniki, Greece 7197). 1997 North American UV Radiometer intercomparisons (Boulder, CO 9/97)

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Mr. Jess Hudson
Bioospherical Instruments Inc.
5340 Riley St.
San Diego CA. 92110-2621
USA

Telephone:	619-686-1888
Telefax:	619-686-1887
E-mail:	jessh@biospherical.com
URL:	http://www.biospherical.com

8. *Major bibliographic references, applicable patents, etc.:*
SUV instruments have been seen nearly a decade of continuous service in the National Science Foundation’s Polar UV Monitoring Network (Anderson et al. 1993; Renavides et al. 1994; Booth et al. 1988-1994; Cullen et al. 1992; Diaz et al. 1990-1994; Frederick et al. 1993; Holm-Hansen et al. 1993; Lubin end Frederick, 1989-1992; Lubin et al. 1989-1992; Madronich 1993,1994; Seckmeyer et al. 1995; Smith et al. 1989-1992; Stamnes 1993; Stamnes et al. 1990-1992).

Identification number: **1.3.0.4.** [129]
Country: **Thailand**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low Resolution Meteorological Receiving (Ground Station)
2. *State of development*: Upgraded and modified all over system
3. *Principle of operation*: Receiving weather data from GMS Satellite

Main technical characteristics

4.1	*application*:	Ground station
4.2	*measuring range*:	Low resolution
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	High performance
4.7	*interface and output details*:	Monitor display
4.8	*power requirements*:	220 VAC 1 phase, 50 Hz
4.9	*servicing interval*:	
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Not completed yet

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Not known yet

7. *Name and adress of person responsible for further information*:

Mr Varesuan Chandraramya
Meteorological Department
4353 Sukhumvit Rd. Bang-Na
Bangkok 10260
Thailand

Telephone: (66-2)3931681
Telefax:
E-mail:
URL: http://

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

Identification number: **1.3.0.5.** [130]
Country: **Thailand**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Precipitation Observation and measuring
2. *State of development*: Upgrade to doppler weather radar
3. *Principle of operation*: To find out: Upper wind, cloud height, wind direction and wind velocity

Main technical characteristics

4.1	*application*:	Precipitation observation
4.2	*measuring range*:	0 to 450 km
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	No limits
4.6	*reliability*:	High reliability
4.7	*interface and output details*:	Display at monitor
4.8	*power requirements*:	220 V 1 phase, 50 Hz
4.9	*servicing interval*:	
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Best accuracy, high reliability and high performance

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Mr Varesuan Chandraramya
Meteorological Department
4353 Sukhumvit Rd. Bang-Na
Bangkok 10260
Thailand

Telephone: (66-2)3931681
Telefax:
E-mail:
URL: http://

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

Identification number: **1.3.0.6.** [165]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Short range, X-band Doppler Weather Radar to Detect and Predict (within 2 to 4 min) Surface Occurence of Wind Shear at Airports. Provides Reflectivity and Doppler Moments.
2. *State of development*: Prototype tested in 1995; improvements in antenna geometry and software in process
3. *Principle of operation*: Flat plate doppler beam to detect surface wind shear/gust fronts. Phased array (six pairs - 12 beams); electronic steering to derive vertical velocity up to 3 km

Main technical characteristics

4.1 *application*:
4.2 *measuring range*: detect/predict hazardous wind shear at airports
4.3 *uncertainty*: 10 to 20 km
4.4 *time constant*: Reflectivity: < 1 dB at S/N ≥ 0 dB; Velocity: < 25 m/s for S/N > 0 dB
4.5 *averaging time*: 40 s for detection
4.6 *reliability*: ≥ 4400 hours MTBF
4.7 *interface and output details*: Wide band fiber optic link from radar to processor/display
4.8 *power requirements*: 120/240 VAC, 60 Hz, 3 wire, 3 A
4.9 *servicing interval*: > 6 months
4.10 *other characteristics*:
Peak power: 80 W, pulse width: 1.25 µs, unambiguous range: 18 km, unambiguous velocity: 66 m/s, beamwidth: ≤ 3.2° (may be changed to 1.6°), upper beam coverage from 6° to 80°, surface beam: linear polarization, weight: < 700 lbs. Easily mounted on airport buildings.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Probability of detection ~ 83%; false alarm rate: 55%. Vertical shear of horizontal wind impacting prediction algorithms. Development planned to improve performance.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: (unknown, but should be very low because: All solid state hardware)

7. *Name and adress of person responsible for further information*:

Mr Salvatore LeMole
Lockheed Martin EP5-104 MD 04
Ocean, Radar & Sensor Systems
P.O. Box 4840
Syracuse, NY 13221-4840
USA

Telephone: (315) 456-2220
Telefax: (315) 456-0847
E-mail: sal.lemole@lmco.com
URL: http://www.syr.lmco.com

8. *Major bibliographic references, applicable patents, etc.:*
- ICAO Journal 49[2](March 1994) on New Technology.

Other entries related to this category:

1.1.02.3
1.1.14.2
2.1.02.18
2.1.03.1
2.1.06.1
2.1.14.1
2.2.01.8
2.2.01.9
2.2.02.3
2.2.03.1

2.1. Measurement of Meteorological Variables

2.1.1. General

Identification number: **2.1.1.1.** [009]
Country: **Switzerland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* THYGAN: Thermo-hygrometer for Automatic Weather Stations; intermittent (2' or 10' operation or steady state operation)
2. *First year of operational use*: 1986
3. *Principle of operation*: - Temperature: Ventilated thermometer, thermocouple CuKonstantan, with fast reaction, no psychrometer effect (intermittent heating of the T-sensor)
   - Humidity: Dewpoint mirror with a diameter of 2 mm and cleaning mechanism, electronically controlled.

Main technical characteristics

4.1	*application*:	- Automatic, ventilated temperature and humidity measurement in the field - Transfer Standard Instrument for T and U in the Laboratory as well as in the field.
4.2	*measuring range*:	Temperature: -50 to +50°C; Dewpoint T: -60 to +50°C
4.3	*uncertainty*:	Dewpoint T: ±0.2 K
4.4	*time constant*:	intermittent (10') or continuous (dewpoint temperature dependent)
4.5	*averaging time*:	10 s
4.6	*reliability*:	One year at least unattended (status test each 10')
4.7	*interface and output details*:	RS232
4.8	*power requirements*:	150 W in severe conditions (icing, snowing, etc.)
4.9	*servicing interval*:	Once a year

4.10 *other characteristics*:
The THYGAN Temperature and Humidity Sensor took part in all major Humidity Intercomparisons of WMO/CIMO: see e.g.:
- Instruments and Observing Methods (CIMO report no. 38, 1989)
- Instruments and Observing Methods (CIMO report no. 49, 1992)
- Sonntag, D.: The WMO Assmann Psychrometer Intercomparison, Instruments and Observing Methods (CIMO report no. 34, 1989)
- Ruppert, P.: THYGAN, Beschreibung der Funktion und Technik, Arbeitsbericht der Schweizerischen Meteorologischen Anstalt, No. 146 (1991)
- WMO/CIMO: Working Group on Surface Measurements, Second Session, Silver spring, April 1997, Final report: Recommendation 9 for CIMO XII, comparison of hygrometers: WMO has now adopted THYGAN sensor as working reference for U.

Experiences and other information

5. *Experience from comparisons and tests performed*:
   THYGAN has Transfer Standard Quality: See e.g.
   - Recommendation 9 for CIMO-XII: Comparison of Hygrometers (Final Report of the CIMO Wg on Surface Measurements, Silver Spring, April 1997)

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 500

7. *Name and adress of person responsible for further information*:
   Dr Bruno Hoegger
   Instrument Department
   Aerological Station

Swiss Meteorological Institute
CH-1530 Payerne
Switzerland

Telephone: +41 (0)26 662 62 11
Telefax: +41 (0)26 662 62 12
E-mail: hoe@sap.sma.ch
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
See: item 4.10 (Other characteristics)

Identification number: **2.1.1.2.** [097]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* DTN receiver
2. *First year of operational use*:
3. *Principle of operation*: data receiver

Main technical characteristics

4.1 *application*: See 4.10, Other characteristics
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 DTN receiver uses 3 specially programmed processors to enable the user to observe information on the DTN Weather Centre screen, while at the same time new information is being downlinked to the receiver

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 adress of person responsible for further information*:
Mr Bryce Anderson,
Chief Meteorologist
DTN Weather Centre
9110 West Dodge Rd.
Omaha, NE 68114
USA

Telephone: (402) 399-6419
Telefax: (402) 255-8180
E-mail: brycea@dtn.com
URL: http://

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

Identification number: **2.1.1.3.** [120]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* MicroTops II is a hand held instrument for measuring the total ozone column. In addition, optionally measures water vapour and aerosol
2. *First year of operational use*: 1996
3. *Principle of operation*: Recently developed high grade interference filters stably detect UVB wavelengths. An on-board computer calculates and stores 850 records.

Main technical characteristics

4.1	*application*:	Climatological and environmental information
4.2	*measuring range*:	Ozone: 305, 312, 320 nm. Water vapour & aerosol: 940-1020 nm
4.3	*uncertainty*:	1 to 2% accuracy
4.4	*time constant*:	Measures and stores a set of in ut data in 300 ms
4.5	*averaging time*:	32 sets of data are input in 10 s and the 3 strongest automatically selected for computation.
4.6	*reliability*:	About 50 instruments in field are preforming properly
4.7	*interface and output details*:	Stores 850 records w/raw and computed data with time and date. Downloads to PC through RS-232C
4.8	*power requirements*:	4×AA alkaline batteries
4.9	*servicing interval*:	We suggest annual calibration

4.10 *other characteristics*:
An internal barometer and an RS-232C are standard. Options include; water vapour, aerosol. The ozone, total vapour calculation and aerosol optical thickness algorithms are programmed into the unit. The results of all scans are stored and can be viewed on the unit's screen. Raw data is also saved in non-volatile memory to allow for retrospective adjustment of algorithms. Each data point is annotated with date, time, site coordinates, solar angle, attitude, pressure and temperature. The unit's accuracy is insured by the highest-grade filters and solid cast aluminum housing. Low-noise electronics and 20-bit A/D converter guaranties high linearity, resolution and dynamic range. An optional plug-in Global positioning System automatically updates coordinates every 2 second.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparisons of MicroTops to Dobson and Brewer instruments are within ±3%

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 400 + shipping (calibration)

7. *Name and adress of person responsible for further information*:

Mr Saul Berger
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URL: http://www.solar.com

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

Morys, M., F. Mims and S. Anderson (1996): "Design, calibration and performance of MICROTOPS II hand-held ozonometer", Presented at the 12th International Symposium on Photobiology, Vienna, 1996.

Other entries related to this category:
1.1.10.1

Identification number: **2.1.2.1.** [039]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HYDRA Dew Point Hygrometer - PC-based field dew point hygrometer measures dew point, ambient temperature, atmospheric pressure, logs data and optionally controls two output relays based on sensor readings.
2. *First year of operational use*: 1997
3. *Principle of operation*: PC-plug in card has microprocessor-control system that monitors external sensor, interfaces with Lab View software running on PC. Both PCI and ISA type cards are available, with support for Windows 3.X, 95, Mac-OS 7&8.

Main technical characteristics

4.1	*application*:	Remote environmental dew point, temperature and pressure collection
4.2	*measuring range*:	Better than 65°C depression.
4.3	*uncertainty*:	0.1°C over ±50°C temperature range
4.4	*time constant*:	< 15 s
4.5	*averaging time*:	Programmable
4.6	*reliability*:	Designed for long-term unattended field use
4.7	*interface and output details*:	Sensors: DB-37 cable (provided), card is plugged directly into host PC or Mac computer. RS-232 (DTE) output can also feed external data logger or Data Management System. System requires customer-supplied PC/Mac running Windows or Mac OS.
4.8	*power requirements*:	110/220/240 VAC 50-60 Hz line 0.5 A typical.
4.9	*servicing interval*:	Annual calibration

4.10 *other characteristics*:
The system is enclosed in customer's PC and the sensorhead is designed to withstand NEMA-4 conditions over a temperature range of ±50°C.

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*:	Communication charges

7. *Name and adress of person responsible for further information*:

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URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
N/A (pending)

Identification number: **2.1.2.2.** [051]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Compact, battery-powered, motor-aspirated psychrometer; Model 27AM180; measures wet and dry bulb temperatures

2. *First year of operational use*: Ca. 1992

3. *Principle of operation*: Switch-operated motor-fan (powered by 3 1.SV D-cells) draws air past wet and dry thermometer bulbs in insulated ducts; adjustable light intensity, night-vision adapted (red) lamp allows measurements to be taken in the dark.

Main technical characteristics

4.1 *application*: Determination of atmospheric relative-humidity
4.2 *measuring range*: 0 to +60°C (others are available)
4.3 *uncertainty*: <0.2°C
4.4 *time constant*: ca. 20s
4.5 *averaging time*: N/A
4.6 *reliability*: ca. 5 years MTBF (depending upon usage)
4.7 *interface and output details*: N/A
4.8 *power requirements*: 4.5 VDC (internal D-cell batteries)
4.9 *servicing interval*: Nil (battery-replacement, wick-change; depends on usage)
4.10 *other characteristics*:

This compact (ca. 25 x 11.5 x 6 cm) motorized psychrometer is ruggedly designed for field work (complying with US Fed. Spec. GG-P-725B) and is completely self-contained (including 3 batteries,: water-bottle, spare wicks). Its thermometer-frame and ducts are removable, allowing use as a sling-psychrometer (by means of its neck/shoulder carrying strap), should the batteries fail in the field. Both the psychrometer and its carrying case (compartmented to hold spare:thermometers, water-bettle, wicks thread and slide rule (to convert wet ’and dry readings to relative-humidity %)) are made of moulded plastic (to eliminate corrosion and facilitate use in any climate).
These thermometers are filled with alcohol, significantly reducing: any health-hazard as well as the high cost for cleanup, storage and disposal of toxic mercury. The slightly higher time constant is not deemed significant for synoptic measurements.

Experiences and other information

5. *Experience from comparisons and tests performed*:
This psychrometer is comparable to the spring-wound clockwork-driven fan types but is superior in ventilation since there is no spring fatigue or strength-depletion to vary the air-flow.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: Nil (batteries, wicks)

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Middleton, W.E.N. and A.F. Spilhaus (1953), Meteorological Instruments, Univ. of Toronto Press, Toronto
- Wexler, A. and W.G. Brombacher, W.G. (1951), Methods of Measuring Humidity and Testing Hygrometers, NBS Circular 512, National Bureau of Standards, Washington, D.C.

Identification number: **2.1.2.3.** [052]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Compact, battery-powered, motor-aspirated psychrometer; Model 27AM160; measures wet and dry bulb temperatures.
2. *First year of operational use*: ca. 1992
3. *Principle of operation*: Switch-operated motor-fan (powered by 3 1.5V D-cells) draws air past wet and dry thermometer bulbs in insulated ducts; adjustable light-intensity, night-vision adapted (red) lamp allows measurements to be taken in the dark.

Main technical characteristics

4.1 *application*: determination of atmospheric relative-humidity
4.2 *measuring range*: -10 to +45°C (others available)
4.3 *uncertainty*: < 0.2°C
4.4 *time constant*: ca. 12 s
4.5 *averaging time*: N/A
4.6 *reliability*: ca. 5 years MTBF (depending upon usage)
4.7 *interface and output details*: N/A
4.8 *power requirements*: 4.5 VDC (internal D-cell batteries)
4.9 *servicing interval*: nil (battery-replacement, wick-change; depends on usage)
4.10 *other characteristics*:
This compact (ca. 25 x 11.5 x 6 cm) motorized psychrometer is ruggedly designed for field work (complying with US Fed. Spec. GG-P-725B) and is completely self-contained (including 3 batteries,: water-bottle, spare wicks). Its thermometer-frame and ducts are removable, allowing use as a sling-psychrometer (by means of its neck/shoulder carrying strap), should the batteries fail in the field. Both the psychrometer and its carrying case (compartmented to hold spare thermometers, water-bottle, wicks, thread and slide rule (to convert wet and dry readings to relative-humidity %)) are made of moulded plastic (to eliminate corrosion and facilitate use in any climate).

Experiences and other information

5. *Experience from comparisons and tests performed*:
This psychrometer is comparable to the spring-wound clockwork-driven fan types but is superior in ventilation since there is no spring fatigue or strength-depletion to vary the air-flow.

6. Costs:

6.1 *unit cost at factory*:
6.2 *annual operating costs*: Nil (batteries, wicks)

7. *Name and adress of person responsible for further information*:

- Wexler, A. and W.G. Brombacher, W.G. (1951), Methods of Measuring Humidity and Testing Hygrometers, NBS Circular 512, National Bureau of Standards, Washington, D.C.

Telephone:
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E-mail:
URL: http://

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

Identification number: **2.1.2.4.** [054]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Digital Subsurface (Soil) Temperature-Gradient Meter; Model 37BM700; measures soil-temperature at surface and 2, 5, 10, 20, 30, 50 & 100 cm depths.
2. *First year of operational use*: ca. 1992
3. *Principle of operation*: tubular probe has metal dishes spaced along its thermally insulated body with electronic temperature sensors embedded in them, connected to a watertight plug-receptacle, at top. Either a digital, battery powered, weather tight control module can be connected, to read the temperatures, or a field datalogger.

Main technical characteristics

4.1 *application*: soil temperature measurements, from surface to 1 m depth
4.2 *measuring range*: -32.0 to +70.0°C
4.3 *uncertainty*: 0.3 °C (or less; depending upon transducer-type)
4.4 *time constant*: ca. 2 in
4.5 *averaging time*: N/A
4.6 *reliability*: ca. 3 year MTBF (electronics)
4.7 *interface and output details*: 10-pole watertight connector, variable resistance output
4.8 *power requirements*: 12 VDC (battery)
4.9 *servicing interval*: N/A (except for battery-changes)
4.10 *other characteristics*:
This was developed to replace the mercury-filled soil thermometers (to eliminate the health-hazard from breakage and reduce costs by eliminating glass), providing much safer and longer life, with better stability and less maintenance, as well as allowing autonomous with an accessory battery-powered, field, waterproof datalogger. Probes are available with thermistor or platinum-resistor transducers, as well as with 8 sensors (down to 100 cm below the surface) or 6 sensors (down to 30 cm).
This eliminates the health-hazard, as well as the high cost for cleanup, storage and disposal of toxic mercury. All of the replacement costs for the fragile glass thermometers are eliminated.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Unbreakable, compared to the traditional liquid-in-glass soil thermometers, and without any mercury hazard. The larger time constant, in air, is not significant in-situ (in soil).

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

7. *Name and adress of person responsible for further information*:

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E-mail: kahl@kahlsico.com
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Middleton, W.E.N. and A.F. Spilhaus (1953), Meteorological Instruments, Univ. of Toronto Press, Toronto

---

Identification number: **2.1.2.5.** [060]
Country: **South Africa**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* temperature and humidity probe for an automatic weather station
2. *First year of operational use*: 1997
3. *Principle of operation*: Capacitive humidity sensor, PRT temperature sensor

Main technical characteristics

4.1	*application*:	Measuring humidity and temperature at AWS
4.2	*measuring range*:	-20 to +50°C, 0 to 100%RH
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	Temperature very reliable, humidity quite reliable
4.7	*interface and output details*:	Coupled to CR10 logger in AWS
4.8	*power requirements*:	12 V battery from 220 V mains or solar panel
4.9	*servicing interval*:	Every 2 months
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	none

7. *Name and adress of person responsible for further information*:

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E-mail:
URL: http://

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

Identification number: **2.1.2.6.** [067]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* ZJ1-2, Hygro-thermograph: Identification with special used temperature slot and humidity box
2. *First year of operational use*: < 1997. It is manufactured in quantity; there are 1500 sets put into operational use every year
3. *Principle of operation*: The principle of bi-metal is used in measurement of temperature. The sensor of human's hair is used in measurement of humidity

Main technical characteristics

4.1 *application*: Measurement of air temperature and humidity
4.2 *measuring range*: -35 to 45°C, 30% to 100%RH
4.3 *uncertainty*: ±1°C, ±5%RH
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: N/A
4.9 *servicing interval*: 18 months
4.10 *other characteristics*:
WJ1 Thermograph
HJ1 Hygrograph
HM10 Hygro thermograph
ZJ Hygro thermograph
HM3 Electric ventilation psychrometer

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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.2.7.** [070]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low-Altitude Boundary Layer Wind-Profiling Radar (Including RASS Temperature Measurement). It could continuously obtain atmosphere horizontal wind, vertical wind and temperature profiles
2. *First year of operational use*: 1997
3. *Principle of operation*: it is a doppler phased-array radar that could continuously detect the three-dimensional atmospheric wind field through the scattering formed by atmospheric turbulence to electromagnetic waves.

Main technical characteristics

4.1 *application*: - research on atmospheric boundary layer and ambient contamination
- research on the variation of global climate
- research on meteorology and climate in polar regions
- Service in airport and research on mid-scale harmful weather
- application in battlefield and response to emergency
- mode established for air flow in city
- application in platforms in coastal water and vessels
- research and application of wind energy

4.2 *measuring range*:
- Wind velocity measurement range: 40 m/s (horizontal); ±10 m/s (vertical)
- Height of sounding in wind detection: 60 to 1500 m
- Temperature measurement altitude: 60 to 1000 m

4.3 *uncertainty*: Wind velocity measurement accuracy: 1 m/s
Accuracy of temperature measurement: ±1°C

4.4 *time constant*: It is a continuous detect instrument, it can work without interruption depend on data requirement

4.5 *averaging time*: 2 to 60 min (programmable)

4.6 *reliability*:

4.7 *interface and output details*: Interface of control software: DOS; Interface of analyses and application: Windows. The result of wind and temperature detection can be outputted in two ways: text file or displayed on computer screen.

4.8 *power requirements*: 220 VAC, 50 Hz, total power consumption: 4 kW

4.9 *servicing interval*:

4.10 *other characteristics*:

Experiences and other information

5. *Experience from comparisons and tests performed*:
- higher accuracy data acquisition than conventional radar
- less costs than others doppler radar with same function
- quick error detection and recovery
- easily control of the device by DOS based software on a PC

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.2.8.** [074]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* 1) The FM electronic radiosonde type TC-2 & C-band radar automatic system with temperature and humidity sensors, 2) The transponder electronic radiosonde TC-3 & L-band secondary radar automatic system with temperature, humidity and pressure sensors
2. *First year of operational use*: 1996. New type is in developing, operational in 1998
3. *Principle of operation*: 1) The FM electronic radiosonde type TC-2 with 403 MHz carrier frequency & C-band with radar automatic system
   2) The L-band secondary radar with 403 MHz ranging transponder & 1671 MHz transmitter Type TC-3 radiosonde automatic system (TPU sensors)

Main technical characteristics

4.1 *application*: Temperature, humidity
4.2 *measuring range*: T: -90 to +50°C, U: 0 to 100%RH
4.3 *uncertainty*: T: < 0.2°C, U: < 3%RH, Wind: < 1 m/s
4.4 *time constant*: T: < 2 s, U: < 1 s (surface conditions)
4.5 *averaging time*: T, U: 4 to 6 s
4.6 *reliability*:
4.7 *interface and output details*: TEMP & PILOT message automatic output interface to communication system
4.8 *power requirements*: 18 ± 2 V, 250 mW
4.9 *servicing interval*: 100 min.
4.10 *other characteristics*:
1) The automatic system reduces two observers
2) Cost effective: a) Price equivalent with the old one, b) reduce the price at least 10% when mass production

Experiences and other information

5. *Experience from comparisons and tests performed*:
An intercomparison with Finnish RS-80 radiosonde & GPS wind system had been finished in 1996

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

7. *Name and adress of person responsible for further information*:
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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
The applicable patents had been obtained by AMS (Beijing), 1997 CMS Document

Identification number: **2.1.2.9.** [075]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HBW interchangable Platinum resistance temperature sensor
2. *First year of operational use*: 1997
3. *Principle of operation*: The sensor consists of a platinum sensor and a passive network. They are all sealed in a stainless steel tube. the passive network is needed for improving the interchangeability of the HBW sensor. Four leads are connected to the sensor, so 4 wires measuring method can be used to reduce error caused by lead resistance

Main technical characteristics

4.1 *application*: soil and water temperature
4.2 *measuring range*: -50 to +80°C
4.3 *uncertainty*: ±0.2°C (-50 to +50°C), ±0.3°C (-50 to +80°C)
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*:
This kind of sensor has excellent interchangeability and long term stability and can be widely used in meteorology, environment protection, etc.

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 adress of person responsible for further information*:

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

Identification number: **2.1.2.10.** [076]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HTF Series Electric Aspirated Psychrometer; temperature and humidity sensor
2. *First year of operational use*: < 1997
3. *Principle of operation*: The HTF series temperature and humidity sensor is designed according to aspirated psychrometer principles. The wet bulb temperature sensor is covered with gauze which is immersed in the water. the evaporation on the surface of the wet bulb depends on the relative humidity and in turn the heat is needed for evaporation causes the depression of wet bulb temperature

Main technical characteristics

4.1 *application*: temperature and humidity
4.2 *measuring range*: 0 to 50°C, 20 to 100%RH
4.3 *uncertainty*: ±0.15°C, ±3%RH
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: Power supply to aspirating motor: 12 VDC, power consumption of motor: 2.2 W
4.9 *servicing interval*:
4.10 *other characteristics*:
The relative humidity can be calculated from the dry temperature, wet bulb depression and air pressure with psychometric formula. Electric motor driven fan ventilates dry and wet temperature sensor surface to keep the wind speed on the sensor surface constant (about 3 m/s). There are shield layers to reduce the radiation error and a water tank to store some water which will be last about a week without refilling. There is also a special device to keep the water level of wet bulb reservoir constant.

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 adress of person responsible for further information*:

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

Identification number: **2.1.2.11.** [081]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* JJT-1 Automatic Synoptic Station
2. *First year of operational use*: < 1997
3. *Principle of operation*: The datalogger samples all the sensors at predetermined intervals of time and the logged dat are processed then the meteorological parameters and their maximum value, minimum value, the times when the extreme value occurred are derived. Under the polling command the data are send to a central computer. The real time meteorological parameters are displayed on a display screen. At the synoptic hours, the synoptic report is generated semi-automatically, the manual observed parameters can be entered to computer via keyboard. Then the hourly data and synoptic report are printed out on the line printer. At the same time all the hourly dat are also filed into a hard disk.

Main technical characteristics

4.1 *application*: Synoptic observations: Air temperature, humidity, air pressure, wind speed and direction, rainfall, soil temperature, solar radiation
4.2 *measuring range*: -50 to +50°C, 15 to 100%RH, 800 to 1060 hPa, 0 to 70 m/s, 0 to 360°, Accumulative rainfall, -50 to +80°C (soil), 0 to 1500 W/m²
4.3 *uncertainty*: ±0.2°C, ±4%RH (before wet bulb freezes)/±6%RH (after wet bulb freezes), ±0.5 hPa, ±(0.4 + 0.3·V) m/s (V: Windspeed), ±5°, ±0.4 mm (rainfall < 10 mm)/±4% mm (rainfall > 10 mm), ±0.3°C (soil), ±1% (converting accuracy, radiation)
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 JJT-1 can measure wind speed wind direction, air temperature, rainfall, soil temperature at different depths, and solar radiation (optional). Its excellent accuracy and high degree of automation made it suitable to be applied at synoptic stations to partially replace manual observations.
The JJT-1 station consists of meteorological sensors, outdoor connection boxes, data logger and a central computer system. The sensors (exclusive air pressure) and outdoor boxes are located at the meteorological observation field. The system is at the office of the observer. All the outdoor sensors are connected to the connection boxes. then the connection boxes are connected to the logger with two pieces of multi-core cable and the distance between the boxes and dat logger may be more than 150 meters, which is enough for most meteorological stations. The pressure sensor is inside the data logger. The data logger and central computer are connected via an RS232 serial interface.

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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.2.12.** [082]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* XDZ-03 Portable Meteorological Observing Instrument
2. *First year of operational use*: < 1997
3. *Principle of operation*: Under the control of a microcomputer, the instrument samples all the sensors, and processes the sampled data, and the measured meteorological parameters, time and voltage of battery are displayed on the LED display and stored in the internal RAM. After measurement the power is turned off automatically in order to save the electric power. The stored data in RAM can be displayed on the LED display with keyboard operations here after.

Main technical characteristics

4.1 *application*: Meteorological observations: Air temperature, humidity, air pressure, wind speed and direction
4.2 *measuring range*: -45 to +50°C, 0 to 100%RH, 600 to 1060 hPa, 0 to 30 m/s, 0 to 360° (Conditions, Operational environment: -40 to +50°C, 0 to 100%RH)
4.3 *uncertainty*: ±0.3°C, ±5%RH (10 to 80%RH)/±8%RH (80 to 100%RH), ±1.0 hPa (T≥-20°C, 800-1060 hPa)/±1.5 hPa (T<-20°C, 600-800 hPa), ±(0.5 + 0.03·V) m/s (V: Windspeed), ±10°
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 instrument consists of three parts: Hand holding part, main part and carrying case. In the hand holding part there are temperature sensor, humidity sensor, wind speed sensor, wind direction sensor, electric measuring compass and an electric ventilation device. The main part consists of microcomputer, pressure sensor, storage battery, display and keyboard. In the carrying case there are also a set of spare storage batteries and a battery charger. The hand holding part and main part all can be put into the carrying case and the whole instrument can be carried by one person.

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 adress of person responsible for further information*:
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8. *Major bibliographic references, applicable patents, etc.:*

Identification number: **2.1.2.13.** [083]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* CQZ-1 Automatic Climate Station
2. *First year of operational use*: < 1997
3. *Principle of operation*: Under the control of the real time clock, the system is turned on at the predetermined time intervals. All the sensors are sampled, processed and then the measured meteorological information is stored into the battery back-up RAM or memory card. After that, the CQZ-1 is turned off immediately to save power, and waits for next sampling in power down status. If it is necessary, the extreme values of some parameters can also be stored at the end of the day. The solar panels charges storage battery via a charge control circuit.

Main technical characteristics

4.1 *application*: Meteorological measurements for climatological purposes of temperature, humidity, pressure, windspeed and direction and rainfall.
4.2 *measuring range*: -45 to +45°C, 0 to 100%RH, 550 to 1060 hPa, 0.5 to 60 m/s, 0 to 360°, accumulative rainfall
4.3 *uncertainty*: ±0.3°C, ±5%RH (<80%RH)/±8%RH (>80%RH), ±0.5 hPa, ±(0.5 + 0.03·V) m/s (V: Windspeed), ±5°, ±0.4 mm (<10 mm)/±4% (≥10 mm)
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 CQZ-1 consists of temperature, humidity, air pressure, windspeed and direction and rainfall sensors, a data logger, RAM memory (or memory card), solar panels and back-up storage battery. there are still several spare channels which can be used for system expansion (sunshine sensor, solar radiation sensor for example).

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 adress of person responsible for further information*:

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

Identification number: **2.1.2.14.** [084]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* NZY-1 Multi-purpose Measuring System for agriculture and forest micro climatology.
2. *First year of operational use*: < 1997
3. *Principle of operation*: Under control of the system clock, the main part is turned on at the predetermined time interval, which is programmable with the keyboard. The main part samples the sensors, processes the sampled data, and the measured results then are displayed on a LED display and printed out on the micro printer and finally turns off the power supply to the main part. When it is needed, the measurement can also be started by manual operation with the keyboard.

Main technical characteristics

4.1 *application*: System to measure Air temperature, wet bulb temperature, soil temperature, photosynthetical active radiation, total radiation and windspeed.
4.2 *measuring range*: 0 to +45°C, 0 to +45°C (wet bulb), 0 to +45°C (soil), 0 to 10,000 W/m², 0 to 10 m/s
4.3 *uncertainty*: ±0.15°C, ±0.15°C (wet bulb), ±0.15°C (soil), ±5% (both radiation parameters), ±(0.2 + 0.3·V) m/s (V=windspeed)
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 NZY-1 system is composed of two psychrometer sensors, two low threshold wind sensors, four soil temperature sensors, two photosynthetical radiation sensors and a pyranometer (net radiation sensor is optional), a junction box and the main part of the instrument. In the main part, there is a data collecting part, a micro printer and a power supply unit. All the sensors are connected to the junction box and this box is connected to the main part via a multi-core cable. The distance between the box and the main part may be more than 100 m. An optional storage battery is adopted as back up power supply.

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 adress of person responsible for further information*:

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

Identification number: **2.1.2.15.** [099]
Country: **Sweden**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* OBS 2000 automatic weather station. Based on standard sensors and data collection hardware from different manufacturers of meteorological equipment; principal Vaisala Oy and Genor A/S.

2. *First year of operational use*: 1996

3. *Principle of operation*: - 16-bit C MOS Microprocessor - controlled automatic system for data acquisition and processing
- Multitasking operation system.
- Multilayer technique.

Main technical characteristics

4.1 *application*: Hourly synoptical and climatological observations.
4.2 *measuring range*: Standard meteorological ranges.
4.3 *uncertainty*: Meets synoptical and climatological requirements for most parameters.
4.4 *time constant*: N/A
4.5 *averaging time*: Varies from 1 min to 24 h.
4.6 *reliability*: Very good.
4.7 *interface and output details*: Modem to telephone line or cellular radio systems. (Mobitex or NMT).
4.8 *power requirements*: 230 VAC
4.9 *servicing interval*: 1 year
4.10 *other characteristics*:
- instrument foundation with a rugged triangular steel construction built on three concrete blocks
- sensors and algorithms for observation of almost all synoptic parameters, including cloud height & amount, visibility and present & past weather
- normal reporting frequency 1/h can be changed by meteorologist in charge to 4/h at severe weather conditions
- >2 months local data storage to save climatological data if the communication link is broken
- automatic local station and sensor supervision; alarms are generated in the local software and transmitted to the acquisition central
- remote parameter setting and downloading of application software

Experiences and other information

5. *Experience from comparisons and tests performed*:
Compares favourable to human observations.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: Including investment costs: US$ 15,000

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8. *Major bibliographic references, applicable patents, etc.:*
- internal technical specifications (Swedish language - not published)
- internal project documents like quality manuals for delivery check, installation, starting-up and service & maintenance (Swedish language - not published)
- Frankenberg, B: "OBS 2000M Algorithms Implemented in SMHI's Automatic Weather Stations" (English language - not published)

- Nordberg, B (1996): "Quality Assurance of Observation Systems at SMHI, a practical example", Nordic Hydrological Conference 1996, vol 1.

Identification number: **2.1.2.16.** [117]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Handar 435E Relative Humidity and Air Temperature (RHAT) sensor.
2. *First year of operational use*: 1996
3. *Principle of operation*: The 435E RHAT sensor measures relative humidity (RH) and air temperature (AT). The RH sensor is a thin hygroscopic film with thin porous electrodes on either side. As humidity changes the permittivity of the film changes. A thermistor is used to measure the air temperature. A solar radiation shield is used to provide natural, smooth air flow past the sensors.

Main technical characteristics

4.1	*application*:	Automatic met stations
4.2	*measuring range*:	RH: 0 to 100% RH, Air T: -50 to +60°C
4.3	*uncertainty*:	RH: ±1.5%, Air T: ± 0.2° (-10 to 60°C); ± 0.4° (-40 to -10°C); ± 0.6° (-50°C)
4.4	*time constant*:	N/A
4.5	*averaging time*:	Averaging done in data collection platform
4.6	*reliability*:	N/A
4.7	*interface and output details*:	RH: 0 to 1 VDC = 0 to 100% RH; Air T: 440kΩ to 2.8kΩ (10kΩ @ 25°C)
4.8	*power requirements*:	4.8 to 30 VDC
4.9	*servicing interval*:	yearly

4.10 *other characteristics*:

1. RH sensor features temperature compensation
2. RHAT sensor has exceptional resistance to contaminants.
3. RHAT sensor has been packaged for remote, harsh environmental conditions.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Qualification testing done by Bureau of Land Management

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.2.17.** [142]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The AW11 Aviation Weather Reporter is a compact weather station. Standard AW11 reports sky condition, visibility, QFE, QNH, Wind speed and direction, temperature and dew point. Precipitation detection is option. Data is output in spoken reports through VHF transceiver and PSTN.
2. *First year of operational use*: 1996
3. *Principle of operation*: Sky condition is processed from laser ceilometer measurements. The ceilometer is based on pulsed lidar technology. The sky condition algorithm is that of FAA AWOS Advisory Circular 150/5220-16B. Visibility measurement employs forward scatter principle. Air pressure is measured by a dual silicon capacitive aneroid digital barometer. QFE and QNH are calculated from station parameters. Wind speed and direction are measured by anemometer WAA151 and wind vane WAV151. Precipitation intensity (Light, Moderate, Heavy) is derived from forward scatter data [optional]. Temperature and humidity is measured with HMP35D probe. Humidity measurement is capacitive and temperature measurement is resistive. Dew point is calculated from temperature and humidity values.

Main technical characteristics

4.1	*application*:	Small airports, heliports, off shore, military applications
4.2	*measuring range*:	Cloud height: 0 to 6400 ft (0 to 2 km), Sky condition : OVC, BKN, SCT, FEW, SKC. Visibility: 50 m to 10 km, QNH, QFE: 600 to 1100 hPa, Wind speed: 0 to 75 m/s
4.3	*uncertainty*:	Reporting resolution : Cloud height resolution 100 ft (0 to 5000 ft), 500 ft (5000 to 6000 ft), Vis. res. 50 m (50 to 5000 m), 100 m (500 to 1000 m), 1 km (1 to 10 km), QNH, QFE resolution 1 hPa / 0.01 inHg, Wind speed 1 kt / 1 m/s, Wind direction res. 10°, Temperature 1°C / 1°F
4.4	*time constant*:	N/A
4.5	*averaging time*:	Sky condition: 30 min, Visibility: 10 min, QNH, QFE: 1 min, Wind speed and direction: 2 or 10 min, Temperature: 5 min, Humidity: 5 min, Precipitation [option]: 2 min (response time)
4.6	*reliability*:	Data not available
4.7	*interface and output details*:	VHF radio 118.000 ... 136.975 MHz, 5W; Telephone (PSTN); Modem, baud rates 300 to 2400, VT100 emulation in term. prog.; Displays [optional]: Remote alpha numeric LCDs and Graphical PC-based Weather Data Monitor
4.8	*power requirements*:	Typical 100 W, max. 700 W including heating
4.9	*servicing interval*:	Optics cleaning and status message check every six months or more often depending on local conditions. Visibility meter calibration once per year. Obstruction light lamp renewal once per year. Pressure, RH and temperature sensor check against reference and calibration if needed once per 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*:	Negligible

7. *Name and adress of person responsible for further information*:

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

Bibliographic references:

- Syrjänen, A. (1996): "Next Generation Automated Weather Observation System", Vaisala News, No. 139, 1996

Patents:

- Measurement system for scattering of light, US Patent No 5,116,124, May 26, 1992
- Method and apparatus for measuring meteorological visibility and scattering of light, said apparatus utilizing common optics for transmission and reception, US Patent No. 5,504,577, Apr.2, 1996
- Other patents pending

Identification number: **2.1.2.18.** [146]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* ROSA Road and Runway Surface Analyzer, models DM31 and DM53, measures road surface temperature, temperature at depth of -7 cm, gategorizes surface state to dry, moist, wet, salted or chemically treated, icy, snowy, or frosty, and gives warnings and alarms of icy conditions.
2. *First year of operational use*: 1995
3. *Principle of operation*: Road surface state analysis is based on electrochemical measurement with open end electrodes at the road or runway surface and on measurements of air temperature, relative humidity, and precipitation intensity. The warnings and alarms of icy conditions are based on trend of surface temperature and the current surface state.

Main technical characteristics

4.1 *application*: Ice Warning and Prediction Systems for roads and runways
4.2 *measuring range*: -40 to +60°C for surface temperature
4.3 *uncertainty*: 0.2 °C in surface temperature, under no solar radiation
4.4 *time constant*: 15 min
4.5 *averaging time*: 1 min for typical measurements, 1 to 10 min for surface state
4.6 *reliability*: MTBF 2 years for DRI50
4.7 *interface and output details*: DRI50 Intelligent Road/runway Sensor Interface
4.8 *power requirements*: 600 mA max. / DRI50
4.9 *servicing interval*: annual service
4.10 *other characteristics*:
One DRI50 interface can measure and analyze data from two surface sensors DRS50 and store 144 data packages corresponding to one day of 10 minutes values. Data is sampled once per minute and a new surface state and warning state is available every minute. Communication options include RS-232, RS-485, analog modems, radio modems, and NMT or GSM cellular systems. The surface sensor DRS50 can stand wear due to traffic down to -4 cm.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Not available third party comparisons and tests yet. A test of salt measurement capability coming soon from TRL in U.K.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 2,500 (Approx., for communication and service)

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
1. Patent "Method and apparatus for determining the covering on a surface" No 2180350 of U.K. Valid also in USA, Canada, Finland, Sweden, Denmark, Germany and Japan.
2. Articles in Vaisala News issues 138/1995 and 144/1997.

Identification number: **2.1.2.19.** [153]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HMP45A and HMP45D Humidity and temperature probes
2. *First year of operational use*: 1997
3. *Principle of operation*: Relative humidity measurement using the capacitive HUMICAP®180 humidity sensor. Temperature measurement using an RTD type temperature sensor.

Main technical characteristics

4.1	*application*:	meteorological measurements at automatic weather stations
4.2	*measuring range*:	relative humidity: 0 to 100%RH, temperature: -40 to +60°C
4.3	*uncertainty*:	relative humidity: ±2%RH (0 to 90%RH)/ ±3%RH (90 to 100 %RH), temperature: ±0.2°C (HMP45A), Pt100 IEC 751 1/3 Class B (HMP45D)
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	MTBF 18.6 years (electronics)
4.7	*interface and output details*:	HMP45A: linear 0 to 1 VDC corresponding to 0 to 100 %RH and -40 to +60°C

HMP45D: same as above except for temperature a 4-wire resistance output

4.8	*power requirements*:	7 to 35 VDC / 4 mA
4.9	*servicing interval*:	typical calibration interval 1 year

4.10 *other characteristics*:
Typical long term stability < 1 %RH / year, IP65 housing for electronics, Interchangeable probe head, EMC protected electronics
To be installed in a radiation shield

Experiences and other information

5. *Experience from comparisons and tests performed*:
Predecessor HMP35D has a 10 year field record in outdoor measurements in automatic weather station applications.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	(no info available)

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
Patents covering the humidity sensor and the measurement principle.

Identification number: **2.1.2.20.** [154]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HMP243: Measurement of temperature and humidity
2. *First year of operational use*: 1995
3. *Principle of operation*: Humidity sensing head is continuously warmed to avoid condensation on the sensor. The heating effect in the humidity measurement is automatically compensated with separate temperature probe.
   The transmitter is microprocessor based where all necessary compensations and linearisations are processed.
   Temperature is measured with Pt-100 (1/4 class B IEC751). Humidity measured with capacitive polymer sensor (HUMICAP®). The transmitter consists of a metal housing for the electronics to which both separate sensing heads with the cables are connected.

Main technical characteristics

4.1	*application*:	measurement of humidity and temperature
4.2	*measuring range*:	Temperature: 0 to 100 %RH, Humidity: -40 to +180°C
4.3	*uncertainty*:	Temperature: Pt-100 1/3 class B IEC751 ±0.1°C, Humidity: up to ±1%RH
4.4	*time constant*:	Temperature: 40 s, Humidity: 15 s.
4.5	*averaging time*:	Temperature/Humidity: < 1 s
4.6	*reliability*:	experimental MTBF > 4 years
4.7	*interface and output details*:	analog outputs: freely scalable within 0 to 10 V and 0/4 to 20 mA limits, RS-232, RS-485 (option), display/keypad (option)
4.8	*power requirements*:	20 to 28 VAC/VDC
4.9	*servicing interval*:	12 months

4.10 *other characteristics*:
a new type more open radiation shield for humidity sensing head is also developed. With the temperature sensing head a traditional radiation shield is used. EMC protected electronics. calculated humidity parameters available (e.g. Td and Tw).

Experiences and other information

5. *Experience from comparisons and tests performed*:
   Tests performed at several meteorological institutes.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
   Patents covering the humidity sensor and the measurement principle.

Identification number: **2.1.2.21.** [155]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* HMP233: Temperature and humidity measurements
2. *First year of operational use*: 1993
3. *Principle of operation*: Microprocessor based transmitter where all necessary compensations and linearisations are processed. Temperature is measured with Pt-100 (1/3 class B IEC751). Humidity measured with capacitive polymer sensor (HUMICAP®). The transmitter consist a metal housing for the electronics to which the sensing head with a cable is connected.

Main technical characteristics

4.1	*application*:	measurement of humidity and temperature
4.2	*measuring range*:	0 to 100%RH, -40 to +120°C
4.3	*uncertainty*:	Temperature: Pt-100 1/3 class B IEC751 ±0.1°C, Humidity: ±1%RH
4.4	*time constant*:	Temperature: 120 s, Humidity: 15 s.
4.5	*averaging time*:	Temperature, Humidity: < 1 s
4.6	*reliability*:	experimental MTBF > 5 years
4.7	*interface and output details*:	analog outputs: freely scalable within 0 to 10 V and 0/4 to 20 mA limits, RS-232, RS-485 (option), display/keypad (option)
4.8	*power requirements*:	20 to 28 VAC/VDC, 93 to 127 VAC, 187 to 253 VAC
4.9	*servicing interval*:	12 months
4.10	*other characteristics*:	

radiation shield for sensing head is needed, EMC protected electronics, calculated humidity parameters available (e.g. Td and Tw)

Experiences and other information

5. *Experience from comparisons and tests performed*:
Tests performed at several meteorological institutes.

6. Costs:

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

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8. *Major bibliographic references, applicable patents, etc.:*
Patents covering the humidity sensor and the measurement principle.

Identification number: **2.1.2.22.** [168]
Country: **Singapore**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Rainfall, Surface temperature, Surface winds and pressure
2. *First year of operational use*: 1995/1996
3. *Principle of operation*: - Rainfall: tipping bucket with digital processing
   - Temperature: resistance type with digital processing
   - Surface pressure en surface wind: All are digital sensors with data loggers and central processing system.

Main technical characteristics

4.1 *application*: Generate one-minute weather observations
4.2 *measuring range*:
4.3 *uncertainty*:
4.4 *time constant*:
4.5 *averaging time*: One minute
4.6 *reliability*: Within specifications
4.7 *interface and output details*: Digital data with computing capability
4.8 *power requirements*: 240 V (Computer), 5 V (sensors)
4.9 *servicing interval*: Monthly, quarterly and annually
4.10 *other characteristics*:

Experiences and other information

5. *Experience from comparisons and tests performed*:
   Rainfall amounts have been compared with the tipping bucket and mechanical manual raingauge

6. Costs:

6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 42,000

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.2.23.** [172]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Air Temperature sensor at 1.5m above ground with radiation shield

2. *First year of operational use*: 1996

3. *Principle of operation*: Platinum resistance sensor for temperature variations, Vaisala HMP 35 A

Main technical characteristics

4.1 *application*: synoptic, climatological and agrometeorological observations
4.2 *measuring range*: -40°C to +60°C
4.3 *uncertainty*: 1/3 DIN 43760B
4.4 *time constant*: 15 s (with membrane filter)
4.5 *averaging time*: 1 minute
4.6 *reliability*: N/A
4.7 *interface and output details*: four wire connection
4.8 *power requirements*: 7 to 35 VDC
4.9 *servicing interval*: ~ 1 year (cleaning interval = 1 month)
4.10 *other characteristics*:

The air temperature sensor is part of the temperature & humidity sonde from Vaisala which is mounted inside a plastic fiber radiation shield. This sensor is connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system.
Every minute this system measures the air temperature, checks it's value, calculates derived variables, looks for extremes values and keeps the data in the active memory, while they are needed.
Every 10 minute the system elaborates 10 minute summaries (instant, average, maximum, minimum and standard deviation values), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
Statistical comparisons for 2 stations, of 1 year data series from automated and classical systems placed at same site revealed very good agreement for dally maximum temperatures.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)
- "Daily maximum temperature data series comparison between simultaeous observations at same location with automated and classical systems" (English version being prepared)

Identification number: **2.1.2.24.** [173]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Air Temperature sensor at 0.05 m above ground level without radiation shield, and
Soil temperature sensors at 0.05m, 0.1m, 0.2m, 0.5m and 1.Om below ground level

2. *First year of operational use*: 1996

3. *Principle of operation*: Platinum resistance sensor for temperature variations, Vaisala DTS 12G

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: -100°c to +100°C
4.3 *uncertainty*: 1/4 DIN 43760B
4.4 *time constant*:
4.5 *averaging time*: 1 min
4.6 *reliability*: not defined
4.7 *interface and output details*: see 4.10
4.8 *power requirements*: 7 to 35 VDC
4.9 *servicing interval*: ~ 1 year
4.10 *other characteristics*:
These 6 temperature sensors are mounted on a plastic tube which is installed at vertical position with 1 sensor above ground and 5 sensors beneath the ground. They are connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system.
Every minute this system measures the air and soil temperature, checks for their values looks for extreme values and keeps the data in the active memory while they are needed.
Every 10 minute the system elaborates 10 minute summaries (instant, average, maximum, minimum and standard deviation values for +0.05m and for -0.05m sensors, for the rest of the sensors only instant values are processed), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data)

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparative data analysis is being made.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

7. *Name and adress of person responsible for further information*:
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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)
- "Daily maximum temperature data series comparison between simultaneous observations at same location with automated and classical systems" (English version being prepared)

Identification number: **2.1.2.25.** [174]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sensor for the relative humidity of the air
2. *First year of operational use*: 1996
3. *Principle of operation*: Capacitive sensor humicap® for relative humidity variations at 1.5m above ground, Vaisala HMP 35 A

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: 0% to 100%
4.3 *uncertainty*: 20°C: ±2% (O% 90%) and ±3% (90% to 100%)
4.4 *time constant*: 15 s (with membrane filter)
4.5 *averaging time*: 1 min
4.6 *reliability*: no defined
4.7 *interface and output details*:
4.8 *power requirements*: 7 to 35 VDC
4.9 *servicing interval*: ~ 1 year(cleaning interval = 1 month)
4.10 *other characteristics*:
The relative humidity sensor is part of the temperature & humidity sonde from Vaisala which is mounted inside a plastic fiber radiation shield. This sensor is connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system.
Every minute this system measures relative humidity, checks it's value, calculates derived variables, looks for extreme values and keeps data 'm the active memory, while it's needed.
Every 10 minute the system elaborates 10 minute summaries (instant, average, maximum, minimum and standard deviation values), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
Two years experience with 22 stations showed that when the air is saturated for long periods (hours and days) these sensors have to be replaced. On the other hand, after more than two years of operation (6 months testing + 20 months operational) about 25% of the sensors need to be calibrated.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.26.** [175]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Atmospheric pressure sensor
2. *First year of operational use*: 1996
3. *Principle of operation*: Set of three aneroid capacitive capsules. Pressure output data is automatically computed to be the time average of the three transducers. Each one is a pressure-frequency converter. [Vaisala DPA 21]

Main technical characteristics

4.1 *application*: synoptic and climatological observations
4.2 *measuring range*: 500 to 1050 hPa
4.3 *uncertainty*: ±0.3 hPa (800 to 1050 hPa and +5°C to +55°C)
±0.5 hPa (500 to 1050 hPa and -40°C to +55°C)
4.4 *time constant*:
4.5 *averaging time*: 0.06 sec.
4.6 *reliability*: not defined
4.7 *interface and output details*: serial line interface RS232C / V.24
4.8 *power requirements*: +5V ± 0.25 V (4 mA) or +12 ± 30/-10% (2mA)
4.9 *servicing interval*: ~ 1 year (cleaning interval = 1 month)
4.10 *other characteristics*:
The atmospheric pressure sensor consists of an electronic board that contains the capsules. This sensor from Vaisala is mounted inside, and is connected to, a data acquisition and processing system, which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system. Every minute this system measures reads the atmospheric pressure, checks it's value, calculates pressure trends, looks for extreme values and keeps the data in the active memory, while they are needed. Every 10 minute the system elaborates 10 minute summaries (instant, average, maximum, minimum and standard deviation values), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
In two years experience with 22 stations we just had 1 pressure sensor off, twice at the same station. Differences between observations made with this electric sensor and classical observations with mercury barometers, are on the order of ±0.2 to ±1.0 hPa.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.27.** [176]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind speed and wind direction sensors
2. *First year of operational use*: 1996
3. *Principle of operation*: Cup anemometer with electric transducer for measure wind speed at 10 m above ground [Vaisala WAA 15A], and wind vane with electric transducer for measure wind direction at 10 m above ground [Vaisala WAV 15A].

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: wind speed: 0.4 to 75 m/s, wind direction O° to 360° (wind speed: 0.3 to 75 m/s)
4.3 *uncertainty*: wind speed ±0.1 m/s (ff < 10 m/s) and ±2%ff(ff ≥ 10 m/s), wind direction: ±2.8°
4.4 *time constant*: wind speed 1.5m (distance constant), wind direction 1.0 m (distance constant)
4.5 *averaging time*: 2 s
4.6 *reliability*: not defined
4.7 *interface and output details*: see § 4.10
4.8 *power requirements*: 11 to 15.5 VDC (20 mA typical)
4.9 *servicing interval*: ~ 1 year
4.10 *other characteristics*:

The surface Wind is measured with cup anemometer and wind vane both fixed on a cross arm mounted at the top of a 10m mast. The sensors are connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system. Every 2 seconds this system measures wind speed and direction, checks it's values, looks for extreme values and keeps the data in the active memory, while they are needed. Every 10 minute the system elaborates 10 minute summaries (instant, average, maximum, minimum and standard deviation values), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
Just a few months after the installation all wind speed sensors, from all the stations had to be removed in order to change the "ball-bearings" that were damage, which caused the winds to be calm most of the time.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

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- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.28.** [177]

Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sensor for the amount and intensity of liquid precipitation.
2. *First year of operational use*: 1996
3. *Principle of operation*: Tipping bucket rain gauge with contact-free electrical switch. Collecting surface area is 200 cm^2 [Lambrecht 15188]. For stations in coldest regions the same sensor is used but equipped with a heather.

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: 0 to 7.5 mm/min. (operative range)
4.3 *uncertainty*: 0.1 mm (resolution)
4.4 *time constant*: N/A
4.5 *averaging time*: 1 minute
4.6 *reliability*: not defined
4.7 *interface and output details*: see §4.10
4.8 *power requirements*: 350 VDC (maximum charge) 0.75 A; 30 VA
4.9 *servicing interval*: ~ 1 year (cleaning interval = 1 month)
4.10 *other characteristics*:

The rain gauge is mounted on a mast in such a way that the collecting surface is 1.5m above ground. The sensor is connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system. Every time the rain water is tipped, the switch closes and an electrical impulse is send to the processing system, which keeps the data 'm the active memory, while they are needed. Every 10 minute the system elaborates 10 minute summaries (total amount and maximum intensity), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparative data analysis is being made.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.29.** [178]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Global radiation sensor
2. *First year of operational use*: 1996
3. *Principle of operation*: Secondary standard pyranometer for measuring solar irradiance on a plane surface. Vaisala CM 11 (made by Kipp & Zonen)

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: 0 to 4000 W/m^2 (spectral range = 305 to 2800 nm)
4.3 *uncertainty*: 4 to 6 $\mu V/Wm^2$ (sensitivity)
4.4 *time constant*: 10^{-4} s (response time)
4.5 *averaging time*: 1 min
4.6 *reliability*: not defined
4.7 *interface and output details*: 700 to 1500 Ohm (Impedance)
4.8 *power requirements*: N/A
4.9 *servicing interval*: 1 year (cleaning interval = 1 day)
4.10 *other characteristics*:

The pyranometer is mounted on a mast in such a way that the base of the sensor is 2.Om above ground. The sensor is connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system. Every minute this system measures the total irradiance, checks it's value and keeps the data in the active memory, while they are needed. Every 10 minute the system elaborates 10 minute summaries in UTC (total amount and maximum intensity of radiation), prepares the data for hourly automatic transition to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transition due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data). On the other hand the Automatic Station prepares, archives and transmits 10 minute summaries of the total irradiance in true solar time.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparative data analysis is being made.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
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- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.30.** [179]
Country: **Portugal**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sensor for detecting rain starting and stopping times.
2. *First year of operational use*: 1996
3. *Principle of operation*: Rain or snow are identified via droplet detection. The sensor is based on a electric circuit that closes with rain drops. The 30° angle position and an internal heating element ensures that the surface dries quickly to evaporate rain droplets (after rain stops) and fog and condensed moisture [Vaisala DRD 11A].

Main technical characteristics

4.1 *application*: Synoptic, climatological and agrometeorological observations
4.2 *measuring range*: N/A
4.3 *uncertainty*: N/A
4.4 *time constant*: < 3 min. (Off-delay, active)
4.5 *averaging time*: 1 minute
4.6 *reliability*: not defined
4.7 *interface and output details*: Rain ON / Ram OFF; 1 to 3 V; 1500 to 6000 Hz; Maximum voltage = 15 V; Maximum current 50 mA
4.8 *power requirements*: 12 VDC ± 10% (15 V DC maximum)
4.9 *servicing interval*: ~ 1 year (cleaning interval = 1 month)
4.10 *other characteristics*:

The rain detector is mounted at the end of an arm with a wind shield. This arm is fixed at a height of, approximately, 1.5m above ground, to the 10m mast. The sensor is connected to a data acquisition and processing system which is part of the Automatic Meteorological Station based on the Vaisala's MILOS 500 system. Every time the droplets fall on the circuit, it closes and an electrical impulse is send to the processing system, which records the date and hour (hh:mm:ss) in a separate archive. Every 10 minute, the data from the rain detector is also used to calculate the rain duration in minutes. The system then prepares the data for hourly automatic transmission to a Regional Concentrator which immediately sends it to a National Concentrator located in Lisbon. If there is no transmission due to telecommunications difficulties then the hourly data is locally archived (maximum capacity is approximately 1 month of full data).

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparative data analysis is being made.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: not available

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
- Vaisala's MILOS 500 User Guide and Vaisala's meteorological sensors manuals.
- "Sistema-Rede de Estações Meteorológicas Automáticas" Lisboa 1995 (available only in Portuguese)

Identification number: **2.1.2.31.** [181]
Country: **Australia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Pt100 - RTD, design with lower mass connector, small diameter stem and high accuracy sensing element.
2. *First year of operational use*: 1994
3. *Principle of operation*: Pt100 - RTD

Main technical characteristics

4.1 *application*: Wet and dry bulb temperatures
4.2 *measuring range*:
4.3 *uncertainty*: ±0.08°C U_{95} (not including measurement electronics)
4.4 *time constant*: 12 s in oil
4.5 *averaging time*:
4.6 *reliability*: No operational failures
4.7 *interface and output details*: 4 wire resistance measurement
4.8 *power requirements*:
4.9 *servicing interval*: > 6 months
4.10 *other characteristics*:

Experiences and other information

5. *Experience from comparisons and tests performed*:
Laboratory test demonstrate minimal stem correction. Therefore suitable for wet bulb use.

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

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.2.32.** [185]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Electrical resistance thermometer
2. *First year of operational use*: 1996
3. *Principle of operation*: The sensor is a platinum resistance thermometer, which is smaller in size to have rapid thermal response.

Main technical characteristics

4.1 *application*: Automatic measurement of temperature at manned or automatic surface station
4.2 *measuring range*: -50 to +50°C
4.3 *uncertainty*: ±0.15°C
4.4 *time constant*: 30 to 40 s
4.5 *averaging time*: 1 min
4.6 *reliability*:
4.7 *interface and output details*: RS232C
4.8 *power requirements*: 12 VDC, 4.5 W
4.9 *servicing interval*: Every month
4.10 *other characteristics*:
This thermometer is installed in an artificially ventilated shield together with a electrical hygrometer.

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 adress of person responsible for further information*:

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

Other entries related to this category:

1.1.03.2
1.1.04.1
1.2.04.2
2.1.05.9
2.1.13.3
2.2.01.2
2.2.01.3

2.1.3. Measurement of atmospheric pressure

Identification number: **2.1.3.1.** [057]
Country: **South Africa**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Measurement of barometric pressure + tendency over 3 hours electronically as well as storage of pressure data every 5 minutes in a loose standing unit.
2. *First year of operational use*: 1997
3. *Principle of operation*: Storage of pressure data from a reliable pressure sensor, like vaisala PA11, on own developed storage module. Changed monthly by amateur observer and sent to nearest weather office. This is to replace barograph.

Main technical characteristics

4.1	*application*:	Storing of barometric pressure at 5 minute intervals, and displaying pressure and APPPP continuously
4.2	*measuring range*:	800 to 1060 hPa
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	Very reliable
4.7	*interface and output details*:	Storage module coupled to PC and downloaded when sent to weather office
4.8	*power requirements*:	220 V
4.9	*servicing interval*:	Monthly to change module
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
As accurate as Vaisala pressure sensor PA11

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Postage, observers remuneration

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.3.2.** [100]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low cost barometric pressure transducer
2. *First year of operational use*: 1995
3. *Principle of operation*: Variable capacitance of ceramic plates (gold plated)

Main technical characteristics

4.1	*application*:	Barometric pressure
4.2	*measuring range*:	0 to 20 psia, 600 to 1100 hPa, 800 to 1100 hPa
4.3	*uncertainty*:	±0.25% FS
4.4	*time constant*:	< 10 ms
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	1/8" push on tubing, 0.5 to 4.5 VDC output
4.8	*power requirements*:	5, 12, 24 VDC; < 0.2 W
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 adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
Patent Nos. 4168518, 4054833

Identification number: **2.1.3.3.** [157]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PTB220 series digital barometers: atmospheric (surface) pressure
2. *First year of operational use*: 1995
3. *Principle of operation*: - uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - microprocessor electronics performing high order linearization and thermal compensation
   - capable of calculating not only prevailing pressure but also three-hour trend and tendency (0...8)

Main technical characteristics

4.1 *application*: measurement of atmospheric (surface) pressure
4.2 *measuring range*: 500 to 1100 hPa abs. / -40 to +60°C
4.3 *uncertainty*: ±0.01% reading / ±0.10 hPa / ±0.2 hPa / ±0.3 hPa
4.4 *time constant*:
4.5 *averaging time*: 1 to 60 s
4.6 *reliability*: MTBF 10 years
4.7 *interface and output details*: RS232C /TTL level / RS485 / RS422 serial interface, also secondary pulse/voltage/current output available
external on/off triggering possible
4.8 *power requirements*: 10 to 30 VDC / 25 to 50 mA
4.9 *servicing interval*: 1 to 3 years
4.10 *other characteristics*:
- configurable digital barometer with several options (accuracy classes, number of pressure transducers etc.)
- available with one, two or three internal pressure transducers for redundant measurement
- available with local display for presentation of pressure and three-hour trend and tendency (0 ... 8)
- available with a wooden carrying case and rechargeable battery for portable applications
- automatic readjustment and recalibration of several PTB220 series barometers in one batch is possible
- separate static pressure head must be used to attenuate wind induced errors
- the PTB220 series barometers are rugged and robust units and tolerate any standard transportation

Experiences and other information

5. *Experience from comparisons and tests performed*:
Long-term stability is generally within ±0.1 hPa per year in the field use and typically ± 0.05 hPa per year in room temperature use.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: (Information not available)

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala.

Identification number: **2.1.3.4.** [158]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PTB100 series analogue barometers: atmospheric (surface) pressure
2. *First year of operational use*: 1994
3. *Principle of operation*: - uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - all analogue electronics

Main technical characteristics

4.1	*application*:	measurement of atmospheric (surface) pressure
4.2	*measuring range*:	900 to 1100 hPa / 800 to 1060 hPa / 600 to 1060 hPa / -40 to +60°C
4.3	*uncertainty*:	±0.3 hPa / ±0.5hPa at room temperature; typically ±1 to 2 hPa over the whole temperature range
4.4	*time constant*:	
4.5	*averaging time*:	about 1 s
4.6	*reliability*:	MTBF 10 years
4.7	*interface and output details*:	0 to 2.5 VDC or 0 to 5 VDC, external on/off triggering possible
4.8	*power requirements*:	10 to 30 VDC / 4 mA
4.9	*servicing interval*:	1 to 3 years
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
   Long-term stability is typically ±_0.1 hPa per year in the field use.
6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	(Information not available)

7. *Name and adress of person responsible for further information*:

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Vaisala Oy
P.O.Box 26
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Finland

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Telefax: (+358 9) 8949485
E-mail: pekka.jarvi@vaisala.com
URL: http://www.vaisala.com

8. *Major bibliographic references, applicable patents, etc.:*
   Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala.

Identification number: **2.1.3.5.** [192]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Digital Barometer
2. *First year of operational use*: < 1997
3. *Principle of operation*: The instrument uses a silicone micro-machined resonator as a detector.

Main technical characteristics

4.1	*application*:	Automatic measurement of pressure at manned or automatic surface station
4.2	*measuring range*:	From 500 to 1300 hPa
4.3	*uncertainty*:	±0.15 hPa
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	RS232C
4.8	*power requirements*:	12 (10.6 to 16.5) VDC, max. 13.5 mA
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 adress of person responsible for further information*:

Ms. Eriko Morishita
Yokogawa Weathac Corporation
85 Hisamatsu-sho, Ashikaga-City
Tochigi 326
Japan

Telephone: 81-284-41-8166
Telefax: 81-284-42-8122
E-mail:
URL: http://

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

Other entries related to this category:

1.1.02.2	2.1.02.25
1.1.02.4	2.1.02.26
1.2.04.2	2.1.02.27
2.1.02.1	2.1.02.28
2.1.02.8	2.1.02.29
2.1.02.11	2.1.02.30
2.1.02.12	2.1.05.12
2.1.02.13	2.2.01.2
2.1.02.15	2.2.01.3
2.1.02.17	
2.1.02.22	
2.1.02.23	
2.1.02.24	

2.1.4. Measurement of humidity

Identification number: **2.1.4.1.** [018]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Closed cycle cryo-cooled dew/frost point hygrometer: Model CR-2
2. *First year of operational use*: 1995
3. *Principle of operation*: Chilled mirror dew/frost point, cooled by closed cycle cryo-cooler

Main technical characteristics

4.1	*application*:	Aircraft, laboratory
4.2	*measuring range*:	-98 to + 15°C
4.3	*uncertainty*:	±0.2°C
4.4	*time constant*:	4 - 15 s (typical)
4.5	*averaging time*:	
4.6	*reliability*:	High: Fundamental measurement process
4.7	*interface and output details*:	analog voltage
4.8	*power requirements*:	approx. 100 W
4.9	*servicing interval*:	Occasional mirror cleaning.
4.10	*other characteristics*:	

No recalibration required.

Experiences and other information

5. *Experience from comparisons and tests performed*:

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	0

7. *Name and adress of person responsible for further information*:

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Buck Research
5375 Western Avenue
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USA

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Telefax: 303 443-2986
E-mail: abuck@igc.org
URL: http://

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

Other entries related to this category:

1.1.02.2	2.1.02.6	2.1.02.21	2.2.01.2
1.1.02.3	2.1.02.10	2.1.02.23	2.2.01.3
1.1.02.4	2.1.02.11	2.1.02.24	
1.1.03.2	2.1.02.12	2.1.02.25	
1.2.05.1	2.1.02.13	2.1.02.26	
2.1.01.1	2.1.02.15	2.1.02.27	
2.1.02.1	2.1.02.16	2.1.02.28	
2.1.02.2	2.1.02.17	2.1.02.29	
2.1.02.3	2.1.02.19	2.1.02.30	
2.1.02.5	2.1.02.20	2.1.02.31	

2.1.5. Measurement of surface wind

Identification number: **2.1.5.1.** [015]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind speed and direction configured as a propeller/vane.
2. *First year of operational use*: 1993
3. *Principle of operation*: A photo-reflector generates 10 pulses per revolution. These pulses counted over a period of time is the wind speed. Direction is obtained through two photo-interruptors in quadrature, i.e.: 90 slots in cylindrical mask = 360°.

Main technical characteristics

4.1	*application*:	Wind sensor
4.2	*measuring range*:	0 - 50 m/s, 0 - 360°
4.3	*uncertainty*:	< 0.45 m/s, < 1.0°
4.4	*time constant*:	
4.5	*averaging time*:	1 s
4.6	*reliability*:	Excellent
4.7	*interface and output details*:	RS232 or 4 - 20 mA or 0 - 10 V
4.8	*power requirements*:	5 - 24 VDC, < 100 mA
4.9	*servicing interval*:	12 months for bearing check.
4.10	*other characteristics*:	

Wind speed:
Sensor: Five bladed propeller
Range: 0 - 50 m/s, accuracy: ±1.0%
Distance constant: < 3.0 m, threshold: 0.36 m/s
Transducer: Optical switch, Frequency: 10 cps

Wind direction:
Sensor: Balanced vane with a 33 cm radius
Range: 360°, no dead band, resolution: 1.0°
Accuracy: < 1.0°, delay distance: < 5.0 m
Threshold: < 0.5 m/s at a 10° deflection.
Damping ratio: 0.53, transducer: Noncontacting optical resolver

Advantages: No deadband, extremely accurate. No wearing parts other than bearings.

Experiences and other information

5. *Experience from comparisons and tests performed*:
This design is a great improvement where the prevailing winds cause a potentiometer direction sensor to wear or where the dead band coincides with the prevailing winds.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	< US$ 25

7. *Name and adress of person responsible for further information*:

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USA

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Telefax: 207-288-3477
E-mail: sales@rainwise.com
URL: http://www.rainwise.com

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

- U.S. General Service Administration Catalog #66-410F
- U.S. Patent # 5,245,874

Identification number: **2.1.5.2.** [056]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Ultra-High-Winds Anemometer, Model 03CM355; measures wind speed and wind direction under all climatic conditions.
2. *First year of operational use*: 1995
3. *Principle of operation*: wind-speed is measured by differential (static and dynamic) air pressures exerted on orifices in a cast-metal housing, heatable under ice-conditions; wind direction is measured by variable resistor.

Main technical characteristics

4.1	*application*:	measurements of very high winds, or under polar conditions
4.2	*measuring range*:	0 to 100.0 m/s (0-200.0 knots), 0 to 360° azimuth
4.3	*uncertainty*:	0.2% or less
4.4	*time constant*:	30 milliseconds (speed & output); vane d.d. = ca. 2 m
4.5	*averaging time*:	5 to 30 min (optional)
4.6	*reliability*:	ca. 5 years MTBF (depending upon site conditions)
4.7	*interface and output details*:	- to 1 VDC, RS232C, RS485 (optional), 300 to 38400 baud
4.8	*power requirements*:	220 V, 50/60 Hz
4.9	*servicing interval*:	nil (depending upon air contamination/debris)

4.10 *other characteristics*:
Previously unattainable durability has now been achieved for measuring very high winds by eliminating any moving speed-sensors (cups, propeller) and using heavy-duty cast-aluminum and stainless-steel for the probe-housing (to withstand impact from debris blown about by such winds). Heaters melt rime-ice, snow, etc. that would otherwise prevent the wind-vane from properly aligning with the wind for the direct-measurement and orientation of the dynamic wind-orifice with the oncoming, incident wind.
Maintenance has been reduced by ruggedization of the probe, The compensation for barometric pressure is automatic. Lightning/transient protection units are available as accessories.

Experiences and other information

5. *Experience from comparisons and tests performed*:
permits wind speed and direction data to be collected under conditions of extremely high winds and/or temperatures below 0°C

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Nil (electrical power)

7. *Name and adress of person responsible for further information*:

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El Cajon, CA 92022-1166
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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- Middleton, W.E.N. and A.F. Spilhaus (1953), Meteorological Instruments, Univ. of Toronto Press, Toronto
- Meteorological Office, 1956, Handbook of Meteorological Instruments, London, Part I

Identification number: **2.1.5.3.** [061]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Model DC120X-Sd, Wind speed & direction recorder
2. *First year of operational use*: 1994
3. *Principle of operation*: Propeller anemometer with electronic recorder

Main technical characteristics

4.1	*application*:	Monitoring wind speed & direction
4.2	*measuring range*:	0.6 to 60 m/s
4.3	*uncertainty*:	±0.7 m/s, ±3° azimuth
4.4	*time constant*:	2.7 m (propeller), 1.3 m (vane)
4.5	*averaging time*:	User selectable
4.6	*reliability*:	
4.7	*interface and output details*:	RS232 serial & PCMCIA Card
4.8	*power requirements*:	120 VAC, 230 VAC & 12 VDC
4.9	*servicing interval*:	12 Months
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 adress of person responsible for further information*:

Mr Leander Nichols
Comptus Inc.
342 Lyndeboro Rd.
New Boston, NH 03070
USA

Telephone: 603 487-5512
Telefax: 603 487-5513
E-mail: comptus@aol.com
URL: http://

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

Identification number: **2.1.5.4.** [077]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* EC9-1 High dynamic performance wind sensor
2. *First year of operational use*: < 1997
3. *Principle of operation*: The sensor uses 3-cup to measure wind speed and vane to measure wind direction. In order to improve dynamic performance and corrosion resistant ability the cup and the vane are all made of carbon fibre strengthened plastics for its excellent strength and light weight.

Main technical characteristics

4.1 *application*: Wind measurements
4.2 *measuring range*: 0 to 70 m/s, 0 to 360°
4.3 *uncertainty*: ±(0.3 + 0.03.V) m/s, where V stands for windspeed; ±3°
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Output level: CMOS compatible
4.8 *power requirements*: 5 V (12 V optimal)
4.9 *servicing interval*:
4.10 *other characteristics*:
A magnetic disk driven by the wind speed sensor shaft and a Hall effect device is used to convert wind speed into an electrical signal which frequency is proportional to the wind speed. a Gray code disk is driven by the wind, and infrared LEDs and phototransistors are used to convert the disk angular position into 7 bit Gray code. This kind of sensors is widely used in those applications where dynamic performance is important such as meteorological observations and aeronautical meteorology.

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 adress of person responsible for further information*:

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No. 1 Qianjin Street
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E-mail:
URL: http://

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

Identification number: **2.1.5.5.** [078]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* VF-1 Low Threshold Wind Speed Sensor
2. *First year of operational use*: < 1997
3. *Principle of operation*: The VF-1 Low Threshold Wind Speed Sensor is 3 cup sensor. low friction and then low threshold can be gained by using magnetic to relief of bearing. The shaft drives a multi-tooth disc, which in turn to cut the light of a photoelectric chopper. then the generated signal is amplified, sharpened and send out. The frequency of output pulse is proportional to wind speed.

Main technical characteristics

4.1 *application*: Wind speed measurement
4.2 *measuring range*: 0 to 20 m/s
4.3 *uncertainty*: ±(0.2 + 0.3.V) m/s, where V stands for wind speed
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Output signal: Pulse frequency, output signal level: TTL compatible
4.8 *power requirements*: 5 VDC
4.9 *servicing interval*:
4.10 *other characteristics*:
This kind of sensors is specially designed for those applications where very low threshold speed are needed such as agriculture, forest, environment evaluation and ecology research

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 adress of person responsible for further information*:

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

Identification number: **2.1.5.6.** [079]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* FC-1 Wind Speed and Direction Sensor
2. *First year of operational use*: < 1997
3. *Principle of operation*: FC-1 sensor consists of a wind speed sensor and a wind direction sensor. the wind speed sensor uses a 3-cup rotator as its sensing element. A multi-tooth disk and a photoelectric chopper are used to convert revolving speed of the rotator into an electric signal which frequency is proportional to the wind speed. the sensing element of wind direction is a single plate windvane. A Gray disk which is driven by the torque of windvane and a set of LEDs and phototransistors are used to convert angular position of the vane into a 6 bit Gray code. This kind of code is adopted for its ability to eliminate any ambiguities in coding.

Main technical characteristics

4.1 *application*: Wind speed and direction measurement
4.2 *measuring range*: 0 to 60 m/s, 0 to 360°
4.3 *uncertainty*: ±(0.3 + 0.03.V) m/s, where V stands for wind speed; ±6° (±3° optional)
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: Power supply: 12 VDC (5 VDC optional), power consumption: 20 mA
4.9 *servicing interval*:
4.10 *other characteristics*:
The sensors can be used in these fields such as meteorology, marine, agriculture, environment monitoring and so on.

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 adress of person responsible for further information*:

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

Identification number: **2.1.5.7.** [080]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* N-DZF Automatic Wind Measuring System
2. *First year of operational use*: < 1997
3. *Principle of operation*: The remote station is turned on at predetermined time intervals under the control of the real time clock. The remote station samples the wind speed and wind direction sensors. then the wind speed and wind direction and their average values are derived. The data logger send these data from a serial port to the transceiver via a modem. After transmission the power supply of the remote station is turned off automatically. the transmitted signals are received at the central station with transceiver and send to computer via modem and serial port. then all the wind data are printed out on the printer.

Main technical characteristics

4.1 *application*: Wind measurements
4.2 *measuring range*: 0 to 90 m/s, 0 to 360°
4.3 *uncertainty*: ±(1 + 0,05.V) m/s, ±10°
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: Solar panels (back up by lead-acid battery)
4.9 *servicing interval*:
4.10 *other characteristics*:
The N-DZF system consists of two parts. One is the remote station, the other is he central station. The remote station is composed of wind speed sensor, wind direction sensor, data logger, modem, radio transceiver, solar panels and storage battery. The remote station is located at the place where the wind parameter is needed. The central station is composed of a microcomputer, modem, radio transceiver and a printer. The central station is at the observer's office. The wind data are transmitted from the remote station to the central station via VHF or UHF communications.

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 adress of person responsible for further information*:

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

Identification number: **2.1.5.8.** [118]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Handar 425A Ultrasonic Wind Sensor and 425AH Heated Ultrasonic Wind Sensor. Measures horizontal wind speed and direction using ultrasound technology. Sensor has no moving parts and has been designed to work in remote environmental applications.
2. *First year of operational use*: 1996
3. *Principle of operation*: The Handar 425A/AH wind sensor uses ultrasound to determine horizontal wind speed and direction. The measurement principle is based on transit time, the time it takes for the ultrasound to travel from one transducer to another which depends on the wind speed along the ultrasonic path. The transit time is measured in both directions. If the wind speed is both directions. If the wind speed is zero the transit times are equal; if there is wind along the sound path the transit times differ and the 425 microcontroller computes the wind speed along the path. This method of measuring for one path is repeated to determine the wind speed along each of the three paths which are offset by 120° with respect to one another. The measurement is independent of altitude, humidity and temperature.

Main technical characteristics

4.1 *application*: Wind applications: Low Level Wind Shear; Automatic Met Station; Aeronautical Met Station
4.2 *measuring range*: Wind Speed: 0-65 m/s, operational; 0-81 m/s, survival Wind Direction: 0-360°
4.3 *uncertainty*: WS: ±0.135 m/s or ±3% of reading up to 49.5 m/s, ± 5% for 49.5 m/s and above;
WD: ±2°
4.4 *time constant*: Response Time: 0.35 seconds
4.5 *averaging time*: 0.15 s
4.6 *reliability*: Calculated MTBF (MIL-HDBK-217E): 26 years
4.7 *interface and output details*: SDI-12; RS-232; Analog: WS - frequency or voltage; WD - simulated potentiometer
4.8 *power requirements*: 10 to 15 VDC for sensor operation; 36 VDC, 0.7 Amp Heater for 425AH
4.9 *servicing interval*: yearly to check sensor, however there are no moving parts to replace
4.10 *other characteristics*:

1. Wind Speed starting Threshold: virtually zero; Wind Direction Dead Band: None
2. No moving parts which eliminates maintenance required by other wind sensors such as replacing bearings.
3. Stainless Steel/anodized aluminum construction making sensor durable to extreme weather conditions. Resistant to contamination and corrosion.
4. Autonomous operation as well as interface with data collection platform in automatic met station.
5. Designed for use in remote outdoor applications.
6. Heated version (425AH) operates over temperature range of -50 to +50±° C.
7. Requires no calibration adjustments. The fundamental accuracy of the sensor is determined by the geometry of the transducers which is closely maintained from unit to unit.
8. The fundamental calibration constant used in the sensor was determined in a wind tunnel with an NIST traceable pressure sensor with pitot tube.
9. The sensor geometry can be verified by physical measurement between the transducers. Handar sells a verifier for use in field units.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Qualified for use with ASOS systems (NWS); Qualified for use in LLWS - Low Level Wind Shear program
(FAA); AWOS certified in AAI NEXWAS system; Comparison testing for EPA and Lawrence Livermore Lab; Qualification testing being done by Bureau of Land Management

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

7. *Name and adress of person responsible for further information*:

Ms Kathryn Schlichting
Handar, Inc.
1288 Reamwood Avenue
Sunnyvale, CA 94089
USA

Telephone: 408-734-9640
Telefax: 408-734-0655
E-mail: marketing@handar.com
URL: http://www.handar.com

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

Identification number: **2.1.5.9.** [121]
Country: **Norway**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Three axis wind measurement sensor with a temperature sensor for marine or corrosive environments
2. *First year of operational use*: 1997
3. *Principle of operation*: Propeller anemometer with hermetically sealed electronics. sensing method is based upon magnetoresistive sensors and a µ-controller with RS-485 output.

Main technical characteristics

4.1 *application*: Vessel and buoy instrumentation
4.2 *measuring range*: 0 to 100 m/s
4.3 *uncertainty*: Absolute accuracy better than 3%
4.4 *time constant*: 1.5 s
4.5 *averaging time*: From 25 ms to 8 s depending on the speed
4.6 *reliability*:
4.7 *interface and output details*: Serial data with RS485 output, 2 Hz
4.8 *power requirements*: 5 V, 6 mA
4.9 *servicing interval*: Every 3 years.
4.10 *other characteristics*:
The instrument can be delivered as 1, 2 or 3 axis unit. For difficult environmental conditions, the instrument can be equipped with seals for protection of bearings. All metal parts are machined from titanium

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$ 20

7. *Name and adress of person responsible for further information*:

Mr Torgeir Jensen
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Norway

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Telefax: +47 73535345
E-mail: jet@sn.no
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Calibration is performed at the windtunnel facility by NTNN in Trondheim, Norway.

Identification number: **2.1.5.10.** [123]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low Level Windshear Alert System (LLWAS) detects and reports windshear and microbursts near airports to the airtraffic controllers. This information is relayed to pilots by the air traffic controllers.

2. *First year of operational use*: 1981, Updated system currently under development. Update system first article available for test early 1998.

3. *Principle of operation*: LLWAS measures wind speed and direction using anemometers sited near the airport runways. The wind information is inputted to the Windshear Microburst Detection Algorithm resident in a PC. The resultant output is the presence of runway oriented hazardous wind shear and microbursts displayed to the air traffic controller.

Main technical characteristics

4.1	*application*:	Aircraft advisories of wind shear conditions
4.2	*measuring range*:	Runways and up to 3 mile runway corridor
4.3	*uncertainty*:	< 5%
4.4	*time constant*:	< 1 min.
4.5	*averaging time*:	20 s
4.6	*reliability*:	95%
4.7	*interface and output details*:	Runway oriented display to air traffic controllers of wind shear and microbursts.
4.8	*power requirements*:	Master station 1400 W; remote station ~10 W
4.9	*servicing interval*:	Once, every 3 months
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
New systems is just installed and are well accepted by Air Traffic Controller

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 50,000 (estimated)

7. *Name and adress of person responsible for further information*:

Mr John Nilsen
FAA/AND-420
800 Independence Ave S.W.
Washington D.C. 20591
USA

Telephone: 202-267-8216
Telefax: 202-267-5536
E-mail:
URL: http://

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

Identification number: **2.1.5.11.** [126]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind monitor SE, wind sensor with serial output
2. *First year of operational use*: 1996
3. *Principle of operation*: Propeller-vane type wind sensor with optical encoder transducer for wind direction

Main technical characteristics

4.1	*application*:	Surface wind measurement
4.2	*measuring range*:	0 to 60 m/s
4.3	*uncertainty*:	±0.3 m/s
4.4	*time constant*:	N/A
4.5	*averaging time*:	1 s
4.6	*reliability*:	
4.7	*interface and output details*:	Serial RS485, polled or continuous; 0 to 5 VDC available
4.8	*power requirements*:	11 to 24 VDC, 20 mA
4.9	*servicing interval*:	2 years typically
4.10	*other characteristics*:	

Operating temperature range: -50 to +50°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*:	< US$ 20

7. *Name and adress of person responsible for further information*:

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URL: http://youngusa.com

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

Identification number: **2.1.5.12.** [131]
Country: **Thailand**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind tunnel: Theodor Friedrichs device, open construction type

Pyranometer: Qualimetrics device, is a Secondary Standard Pyranometer, model 3016

2. *First year of operational use*: < 1997

3. *Principle of operation*: Wind tunnel: Open construction type, established in 1994, used for anemometers comparisons and calibration

Main technical characteristics

4.1	*application*:	Ease of reading and manipulation
4.2	*measuring range*:	The scale is suitable for local measurement
4.3	*uncertainty*:	Should be neglected
4.4	*time constant*:	For recording instrument
4.5	*averaging time*:	For wind measurement
4.6	*reliability*:	Instrument should be able to maintain or calibration may be compatible with the other requirements
4.7	*interface and output details*:	
4.8	*power requirements*:	220 V, 1 phase, 50 Hz
4.9	*servicing interval*:	at least 5 years
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Reliable, accurate, convenient of operation and maintenance, robust and durable.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 300

7. *Name and adress of person responsible for further information*:

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URL: http://

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

- Handbook of Meteorological Instruments, Her Majesty’s stationary office, London, 1956
- Guide to Meteorological Instruments and Methods of Observation (WMO No. 8, TP 3)
- Knowles Middleton, W.E., "Meteorological Instruments", F.R.S.C. National Research Council of Canada

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Identification number: **2.1.5.13.** [147]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low Cost Single Channel Wind Display
2. *First year of operational use*: 1997 (June)
3. *Principle of operation*: Single channel wind display - wind speed and direction. High intensity LED technology w. automatic brightness control. On-line configurable. Digital, analog and serial i/o for sensors and transmitters. Slim line, mountable on desk, wall, ceiling or panel.

Main technical characteristics

4.1 *application*: Boat clubs, harbours, sport & leisure
4.2 *measuring range*: any
4.3 *uncertainty*: sensor/transmitter dependent
4.4 *time constant*:
4.5 *averaging time*: configurable (upto 25 s)
4.6 *reliability*: MTBF (failures/10^6 h) = 8.28
4.7 *interface and output details*: digital, analog and serial i/o
4.8 *power requirements*: 10.5 to 15.5 VDC
4.9 *servicing interval*: ref. MTBF-value
4.10 *other characteristics*:
Basic instrument for simple point-to-point wind systems

Experiences and other information

5. *Experience from comparisons and tests performed*:
IEC 68-2-2, IEC 68-2-1, IEC 68-2-34/36, EN 55022, IEC 801-3, EN 55022DC, IEC 801-4, IEC 801-2

6. Costs:

6.1 *unit cost at factory*:
6.2 *annual operating costs*: ref. MTBF

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.5.14.** [148]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Multichannel Averaging Wind Display
2. *First year of operational use*: 1997 (June)
3. *Principle of operation*: Multichannel averaging wind display - wind speed, gusts and direction w. variance. High intensity LED technology w. automatic brightness control. On-line configurable. Digital, analog and serial i/o for sensors and transmitters. Slim line, mountable on desk, wall, ceiling or panel.

Main technical characteristics

4.1 *application*: Harbours, ships, industry, met. offices
4.2 *measuring range*: any
4.3 *uncertainty*: sensor/transmitter dependent
4.4 *time constant*:
4.5 *averaging time*: 5 s, 2 min and 10 min
4.6 *reliability*: MTBF (failures/10^6 h) = 17.16
4.7 *interface and output details*: digital, analog and serial i/o
4.8 *power requirements*: 10.5 - 15.5 VDC
4.9 *servicing interval*: ref. MTBF-value
4.10 *other characteristics*:
General purpose averaging wind display for multiple site applications

Experiences and other information

5. *Experience from comparisons and tests performed*:
IEC 68-2-2, IEC 68-2-1, IEC 68-2-34/36, EN 55022, IEC 801-3, EN 55022DC, IEC 801-4, IEC 801-2

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

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.5.15.** [186]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Propeller anemometer and vane
2. *First year of operational use*: 1996
3. *Principle of operation*: Wind speed is observed by propeller anemometer and wind direction is observed by vane with the digital angle-encoder disks. Weight of the body was reduced to have a rapid response time.

Main technical characteristics

4.1	*application*:	Automatic measurement of windspeed and wind direction at manned or automatic surface station
4.2	*measuring range*:	0 to 360°, 0.3 to 90 m/s
4.3	*uncertainty*:	Wind direction: ±2°, Wind velocity: ±0.2 m/s (~10 m/s), ±2% (10 m/s)
4.4	*time constant*:	Response length (distance constant): 5 m, damping ratio (10.0 m/s): 0.3 to 0.5
4.5	*averaging time*:	3 s
4.6	*reliability*:	
4.7	*interface and output details*:	8 bits gray code
4.8	*power requirements*:	12 VDC, 0.1 A
4.9	*servicing interval*:	Every 3 months
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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.5.16.** [193]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind sensor (TYPE A7401)
2. *First year of operational use*: < 1997
3. *Principle of operation*: Wind speed is observed by propeller anemometer and wind direction is observed by vane with the photoelectric-encoder system or AC synchronous system. Weight of the body was reduced to have a rapid response time.

Main technical characteristics

4.1	*application*:	Automatic measurement of wind speed and wind direction at manned or automatic surface station
4.2	*measuring range*:	Wind Direction: 0 to 360°. Wind Speed: 0.4 to 90 m/s.
4.3	*uncertainty*:	Wind direction: Within ±3°. Wind Speed: Within ±0.3 m/s (for < 5 m/s), ±5% (for > 5 m/s)
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	Wind Direction: 5 bit GRAY-Code and AC Synchronous, Wind speed: Constant current pulse signal
4.8	*power requirements*:	12 VDC, approx 60 mA
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 adress of person responsible for further information*:

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URL: http://

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

Other entries related to this category:

1.1.02.2	2.1.02.14	2.1.02.27
1.1.02.4	2.1.02.15	2.1.02.28
1.2.04.2	2.1.02.17	2.1.02.29
1.3.00.6	2.1.02.22	2.1.02.30
2.1.02.7	2.1.02.23	2.2.01.2
2.1.02.11	2.1.02.24	2.2.01.3
2.1.02.12	2.1.02.25	2.2.04.1
2.1.02.13	2.1.02.26	

Identification number: **2.1.6.1.** [058]
Country: **South Africa**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Storage of amount and frequencies of rainfall, using a storage module, from a tipping bucket raingauge
2. *First year of operational use*: 1997
3. *Principle of operation*: Storage module coupled to a good quality raingauge in a loose standing unit. This is to replace autographic raingauges

Main technical characteristics

4.1	*application*:	Storing of rainfall data up to 1500 mm
4.2	*measuring range*:	Every 0.2 mm
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	As reliable as good quality tipping bucket; ±2% at 100 mm/h
4.7	*interface and output details*:	Storage module, changed monthly and sent to weather office where downloaded by PC
4.8	*power requirements*:	4 to 1.5 V batteries
4.9	*servicing interval*:	Monthly to change memory module and clean raingauge, 6 monthly to change batteries
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent, compare very well with standard raingauge

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Postage, observer numeration, batteries

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.6.2.** [068]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* SL1 Remote Rainfall recorder. The data of display of the rainfall amount is compared with the data of the rainfall cup
2. *First year of operational use*: 1997. There are 500 sets put into operational use every year
3. *Principle of operation*: Use the standard tipping bucket to output pulse and display the data and record it

Main technical characteristics

4.1 *application*: Measurement of rainfall volume
4.2 *measuring range*: 0 to 10 mm, or 0 to 50 mm
4.3 *uncertainty*: ±0.4 mm (under 10 mm), ±2 mm (under 50 mm)
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: 220 VAC, 50 Hz or 12 VDC
4.9 *servicing interval*: 12 months
4.10 *other characteristics*:
1. SM1 Rainfall Recorder
2. SJ1 Siphon Rainfall Recorder
3. SL1 Remote Rainfall Recorder
4. SL3 Sensor of Remote Rainfall Recorder

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 adress of person responsible for further information*:

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E-mail:
URL: http://

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

Identification number: **2.1.6.3.** [071]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Measuring intensity, velocity and spectrum field of the precipitation at real time
2. *First year of operational use*: 1997
3. *Principle of operation*: Through the scattering of precipitation drops to electromagnetic waves and by the doppler effect of the moving object, three parameters of echo intensity, velocity and spectrum can be detected continuously.

Main technical characteristics

4.1 *application*: Severe weather observations, now- and forecasting
4.2 *measuring range*: 450 km
4.3 *uncertainty*: Intensity: 1 dB, velocity: ±0.5 m/s
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Control software (DOS), real time display and product producing
4.8 *power requirements*:
4.9 *servicing interval*:
4.10 *other characteristics*:
- Two types of antenna: Planet and parabolic antennas
- Radar can be installed on a vehicle
- Real time wind and temperature data gain

Experiences and other information

5. *Experience from comparisons and tests performed*:
- This radar is installed on a vehicle, so it is convenient to get it to almost anywhere
- Real time data gain
- High accuracy data than other ordinary types of observation
- Range of height stratification is 30 m
- Less cost than other instrument with the same function

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

7. *Name and adress of person responsible for further information*:

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URL: http://

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

- Li Xintian, Tian Wenbin and Bu Xiangyuan (1996): "Wind-profiling Radar and Radio-Acoustic Sounding System (RASS)", Proceedings of CIE 1996 International Conference on Radar, pp. 64-67
- Rogers, R.R., S.A. Cohn and W.L. Echlund (1994): "Experience from one year of operating a boundary-layer profiler in the centre of a large city", Annales Geophysicae 12[6](1994)529-540 (Germany, ISSN: 0992-7689)
- Tian Yalong (1990): "Research of RASS Detection by UHF Wind Profiler Radar", Master Paper of the Chinese Academy of Meteorological Science
- Huang Changheng, Qi Rundong and Tian Wenbin (1991): "UHF Doppler Wind-profiling Radar and Performance Analyses", Proceedings of CIE 1991 International Conference on Radar, pp. 64-67

Identification number: **2.1.6.4.** [073]
Country: **China**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Horizontal gauge, which measures horizontal precipitation. Function: Correction of wind-caused error of precipitation measurements

2. *First year of operational use*: 1992

3. *Principle of operation*: The projection amount of horizontal precipitation vector in falling direction of the water particles is called horizontal precipitation. Principle: Both of wind-caused error and horizontal precipitation depend on several same factors, such as wind speed, dropsize distribution, type of precipitation (rain or snow)

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*:
Correction of wind-caused error is carried out only by applying horizonal gauge, which is as simple as general gauge. This method is very suitable for correcting point precipitation (rain or snow) measurements of routine observations. Corrections are very accurate and simple.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparing about 15000 events between pit gauge, national gauge and horizontal gauge, the exponential correlation between horizontal precipitation and absolute difference in catch between by national gauge and by pit gauge was confirmed. Adjusted error distribution is similar to distribution of random error of precipitation. Adjusted accuracy approaches pit gauge level.

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

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- design of Horizontal Gauge
- correction of wind-caused error precipitation measurements using horizontal precipitation
- Patent: ZL 96 2 22904.0

Identification number: **2.1.6.5.** [127]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Tipping bucket rain gauge
2. *First year of operational use*: 1996
3. *Principle of operation*: Tipping bucket rain gauge, magnetic reed switch

Main technical characteristics

4.1	*application*:	Precipitation measurements
4.2	*measuring range*:	
4.3	*uncertainty*:	2% to 25 mm/h, 3% to 50 mm/h
4.4	*time constant*:	N/A
4.5	*averaging time*:	N/A
4.6	*reliability*:	N/A
4.7	*interface and output details*:	Magnetic reed switch, N.O.
4.8	*power requirements*:	18 W (for heater only)
4.9	*servicing interval*:	2 years typically
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 adress of person responsible for further information*:

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URL:	http://youngusa.com

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

Identification number: **2.1.6.6.** [137]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The PWD11 measures visibility, detects precipitation type, detects precipitation intensity and precipitation accumulation and estimates snow accumulation. Reports WMO and NWS codes. The sensor can be used independently to make remote measurements or to control variable messages or traffic signs.
2. *First year of operational use*: 1997
3. *Principle of operation*: The PWD11 combines information from optical forward scatter measurement and capacitive precipitation measurement using signal analysis and artificial intelligence type algorithm.

Main technical characteristics

4.1 *application*: Highways, Road weather stations, harbours and coastal areas
4.2 *measuring range*: Visibility 10 ... 2 000 m
4.3 *uncertainty*: Optical measurement consistence better than 5 %
Precipitation detection sensitivity 0.10 mm/h (liquid prec.) or better
Precipitation accumulation ±30% in light or moderate rain
4.4 *time constant*: N/A
4.5 *averaging time*: 1 minute
4.6 *reliability*: Data not available
4.7 *interface and output details*: RS232, RS485; two programmable relay controls
4.8 *power requirements*: 15 W without heaters, max. 20 W
4.9 *servicing interval*: Window cleaning with regular interval
4.10 *other characteristics*:
Field calibration can be carried out in practically any weather conditions using a calibration kit. Extensive self diagnostics monitors continuously the status of the sensor. Excessive contamination or lens blockage are detected automatically.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comprehensive evaluation test in progress at Jokioinen observatory, Finland.

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
Haavasoja, T., P. Nylander, M. Sairanen, L. Ström, P. Survo and P. Utela (1996): "A Present Weather Detection for Highways", 8th International Road Weather Conference, 17-19 April, 1996

Identification number: **2.1.6.7.** [138]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The FD12P measures visibility, detects type of precipitation, measures intensity of precipitation, calculates accumulation of precipitation, calculates water equivalent of frozen precipitation and snow accumulation. Reports 50 SYNOP codes or NWS codes for present weather.
2. *First year of operational use*: 1993
3. *Principle of operation*: The FD12P uses forward scatter signal analysis and heated capacitive surface sensor signal combined by the device software in real time.

Main technical characteristics

4.1 *application*: MOR, precipitation type and intensity for airports, weather stations, etc.
4.2 *measuring range*: Visibility: 10 to 50 000 m
Precipitation type: rain, drizzle, snow, sleet, snow grains, ice pellets, freezing rain, freezing drizzle.
Precipitation intensity: < 1000 mm/h
4.3 *uncertainty*: Consistency ±4 %
4.4 *time constant*: N/A
4.5 *averaging time*: Visibility : 1 min and 10 min
Present Weather : 90 s, 15 min and 1 h
4.6 *reliability*: MTBF (predicted) > 10 000 hours
4.7 *interface and output details*: RS232, RS485
4.8 *power requirements*: 35 W + 100 W for hood heaters
4.9 *servicing interval*: Window cleaning and calibration every six months or more often depending on location
4.10 *other characteristics*:
Field calibration can be carried out in practically any weather conditions using a calibration kit. Extensive self diagnostics monitors continuously the status of the sensor.
Excessive contamination or lens blockage are detected automatically. Freezing rain, mist and dry aerosols are determined indirectly. Many analysis parameters are user selectable.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Numerous tests and evaluations has been carried out. Please refer to § 8, bibliographic references.

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
Bibliographic references:
- Lönnqvist, J. and P. Nylander, A Present Weather Instrument, WMO technical conference on Instruments and Methods Observation, 49, 1992.
- Performance data of Vaisala FD12P present weather and visibility sensor for use in AWOS in compliance with FAA advisory circular AC150/5220-16A , 1993 (not published).
- Haavasoja, T., J. Lönnqvist and P. Nylander (1994): "Present Weather and Fog Detection for Highways", Seventh Road Conference, Seefeld 21-22.3, 1994
- Andersson, T., S. Bandalo, E. Elomaa, T. Hovberg and P. Valkovuori (1994): "Present Weather Sensor Field Test and Intercomparison", WMO technical conference on Instruments and Methods Observation,

Geneva, Switzerland, 28 Feb. -2. March, 1994.
- van der Meulen, J. (1994): "A Comparison of Two Present Weather Systems with Human Observations", WMO technical conference on Instruments and Methods Observation, Geneva, Switzerland, 28 Feb. -2. March, 1994.
- Stepek, A., D.W. Jones and D.B. Hatton (1994): "Winter 92/93 Present Weather Sensor Field Trial", WMO technical conference on Instruments and Methods Observation, Geneva, Switzerland, 28 Feb. -2. March, 1994.
- Hedegaard, K. (1994): "Test of Vaisala's Present Weather Sensor ved DMI", DMI internal report, 1994.
- Barnett, A. (1997): "The Vaisala FD12P Eskdalemuir Field Trials", UK Met. Office internal report, 1997.
- Instrumentenamt Hamburg, Testbericht-Nr: 1993/2 Present Weather Sensor, DWD internal report, 1995.
- Engfer, D. (1995): "Resultate aus den Verleichen der Messdaten vom Present Weather Sensor FD12P mit den Metarmeldungen", Swiss Meteo internal report, 1995.
- Huges STX Corporation, Winter Performance Evaluation for the Vaisala FD12P Precipitation Identification Sensor, NWS internal report, 1996.
- Aaltonen, A., E. Elomaa, A. Tuominen and P. Valkovuori, Measurement of Precipitation, WMO conference in Bratislava, August 1993.

Patents :
- Method and apparatus for measuring prevailing weather and meteorological visibility, US patent No. 5,434,778, Jul. 18, 1995. Patented also in several other countries.

Identification number: **2.1.6.8.** [180]
Country: **Australia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Tipping bucket raingauge with siphon, dual reed switch and logger.
2. *First year of operational use*: 1995
3. *Principle of operation*: A syphon moulding ~ 1.3 buckets of rainfall controls flow of water into bucket limiting over fill a high rainfall rates.

Main technical characteristics

4.1	*application*:	Precipitation measurement
4.2	*measuring range*:	0 to 650 mm/h in 0.2 mm steps
4.3	*uncertainty*:	3% (0 to 250 mm/h), 4% (250 to 350 mm/h)
4.4	*time constant*:	variable
4.5	*averaging time*:	0.2 mm
4.6	*reliability*:	
4.7	*interface and output details*:	Reed switch pulse to AWS; reed switch pulse to logger.
4.8	*power requirements*:	Internal battery to logger
4.9	*servicing interval*:	6 months
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Use in the field has identified that particularly in tropical climates the tungsten bearing may corrode

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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Australia

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

Identification number: **2.1.6.9.** [200]
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, intensity and drop size distribution
2. *First year of operational use*: 1992, commercialized (Andrew Antenna Canada Ltd.)
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.

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 min
4.5 *averaging time*: 1 min
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 VAC
4.9 *servicing interval*: Approximately 1 year
4.10 *other characteristics*:
Designed to operate in the diverse Canadian Climate with our AWOS (Automatic Weather Observing System) also known as 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. Evaluated in WMO Present Weather Sensor Intercomparison. Units also being evaluated by U.S., Britain, Japan and Germany.

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

7. *Name and adress of person responsible for further information*:

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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Being manufactured by Andrew Canada Inc., Fax #: 905-668-8590

Identification number: **2.1.6.10.** [202]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Rosemount 872 icing sensor
2. *First year of operational use*: 1992; cooperative venture with private industry (Rosemount Inc.). To be done: Minor software changes to be made prior to resumption of field testing.
3. *Principle of operation*: Vibrating cylinder, frequency shift used to detect presence and amount of icing.

Main technical characteristics

4.1 *application*: Automatic present weather observations
4.2 *measuring range*: -50°C to +50°C
4.3 *uncertainty*:
4.4 *time constant*: Instantaneous
4.5 *averaging time*: Instantaneous
4.6 *reliability*:
4.7 *interface and output details*: RS232
4.8 *power requirements*: 110 VAC (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 AWOS (Automatic Weather Observing System) also known as READAC (Remote Environmental Automatic Data Acquisition Concept) Autostation.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Tested at various Canadian locations. Used operationally at about 100 sites.

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

7. *Name and adress of person responsible for further information*:

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

Other entries related to this category:

1.1.02.2	2.1.02.15	2.1.02.26	2.3.00.4
1.1.02.4	2.1.02.17	2.1.02.27	
1.1.05.1	2.1.02.22	2.1.02.28	
1.3.00.6	2.1.02.23	2.1.02.29	
2.1.02.11	2.1.02.24	2.1.02.30	
2.1.02.13	2.1.02.25	2.1.13.2	

2.1.7. Measurement of radiation

Identification number: **2.1.7.1.** [032]
Country: **Lithuania**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Ångstrom Compensational Pyrheliometer Standard instrument functions
2. *First year of operational use*: 1997
3. *Principle of operation*: According to WMO No. 8, 7.2.1.2

Main technical characteristics

4.1 *application*: (As above) Standard for the calibration of pyranometers
4.2 *measuring range*:
4.3 *uncertainty*:
4.4 *time constant*: 3 to 5 s
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: 6 VDC
4.9 *servicing interval*: Comparison every 5 years
4.10 *other characteristics*:

Experiences and other information

5. *Experience from comparisons and tests performed*:
Normal operation

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

7. *Name and adress of person responsible for further information*:

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Telefax: (370-2) 72 41 60
E-mail:
URL: http://

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

Identification number: **2.1.7.2.** [036]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* RSS (visible) and UVRSS (UV): narrow band spectroradiometers for fully automatic spectral irradiance measurements in remote field locations with automatic measurement of global, diffuse, and direct radiation.

2. *First year of operational use*: In production late 1997, prototypes tested during US Dept. of Agriculture 1997 UV-B intercomparison at Boulder CO, USA. Two versions available.

3. *Principle of operation*: Light enters the instrument through an optimized fore optic that is alternately shaded and unshaded by a motorized shadowband. Light passes through a precision laser machined optical slit onto the primary relay lens where it then passes through two prisms and is refracted. At the exit of the secondary lens the refracted light illuminates a diode array detector in the RSS, or a cooled, back thinned CCD device in the UVRSS. A 16 bit A/D samples the detector and reports the data via an RS-232 port.

Main technical characteristics

4.1 *application*: Field/laboratory installations to measure visible/UV spectral irradiance.
4.2 *measuring range*: RSS: 400 to 1000 nm (visible); UVRSS: 300 to 410 nm (UV-B & UV-A)
4.3 *uncertainty*: < 5%
4.4 *time constant*: N/A, depends on wavelength
4.5 *averaging time*: Programmable from seconds to minutes
4.6 *reliability*: Designed for long term unattended operation in the field
4.7 *interface and output details*: Serial communication via modem, optional ethernet or PCMIA memory
4.8 *power requirements*: 110/220/240 VAC, 50-60 Hz
4.9 *servicing interval*: Clean instrument's fore optic once a month, annual calibration
4.10 *other characteristics*:
This instrument uses prism and CCD technology to eliminate order sorting filters and complex mechanical mechanisms and to greatly reduce the time required to acquire a complete scan. It has only one internal moving part (a shutter) Long term reliability and stability are also increased, and the external motorized shadowband allows calculation of direct and diffuse as well as total irradiance.

Experiences and other information

5. *Experience from comparisons and tests performed*:
To be published 1998 AMS Met Obs.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 5995 (annual calibration)

7. *Name and adress of person responsible for further information*:
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Telefax: (+1) 413 863-0255
E-mail: info@yesinc.com
URL: http://www.yesinc.com

8. *Major bibliographic references, applicable patents, etc.:*
N/A (pending)

Identification number: **2.1.7.3.** [040]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Multifilter rotating shadowband radiometer. MODEL MFR-7 (visible), UVMFR-7 (ultraviolet) , SDR-1 (broadband)- field instrument to measure total, diffuse, and direct narrowband solar irradiance at discrete wavelengths from the UVB (300 nm) to the near IR (940 nm).
2. *First year of operational use*: 1991
3. *Principle of operation*: An onboard microprocessor controls a shading band to make blocked (diffuse) and unblocked (total) measurements of the instrument diffuser. The system then computes the direct-normal from the total and diffuse readings, providing three components of solar irradiance with one detector. Data are downloaded to a host computer for processing with the supplied software. Unique algorithms perform angular correction on the shadowband data, resulting in a superior cosine response, and also perform optical depth retrievals through automated Langley analysis. Includes YESDAS-2 control system and data logger.

Main technical characteristics

4.1	*application*:	Visibility and column aerosol studies, atmospheric turbidity, optical depth, column ozone, column water vapour, biological impact, solar resource monitoring, UV monitoring, cloud behaviour
4.2	*measuring range*:	415, 500, 615, 673, 870, 940 nm at 10 nm FWHM, and 300, 305, 311, 317, 325, 332, and 368 nm at 2 nm FWHM. A broadband visible channel measures from 380 to 1050 nm.
4.3	*uncertainty*:	< 3% with angular correction
4.4	*time constant*:	< O.1 s
4.5	*averaging time*:	15 s (20 s for UV channels)
4.6	*reliability*:	Rugged field instrument designed for continuous outdoor use
4.7	*interface and output details*:	Instrument wired to datalogger with -4.096 to +4.095 output voltage; RS-232 port for direct serial connection also accepts telephone modems and removable PCMCIA memory card, satellite telemetry option
4.8	*power requirements*:	110/220 VAC, 50/60 Hz (50W maximum) or 12 VDC @ 1.5 A, 50% duty cycle, and 3 A, 50% duty cycle
4.9	*servicing interval*:	Annual calibration; check diffuser and band alignment regularly
4.10	*other characteristics*:	

System is fully calibrated and supplied with files to apply calibration constants and angular correction

Experiences and other information

5. *Experience from comparisons and tests performed*:
Has participated in US Department of Energy Atmospheric Radiation and Measurement (ARM) program Intensive Operational Periods from 1994 through present. Also participated in US Dept. of Agriculture UV-B intercomparisons at Boulder, CO, USA from 1994-97 as well as WMO meeting in July of 1997 in Thessaloniki, Greece.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 1,495 for calibration

7. *Name and adress of person responsible for further information*:

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URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
- Beaubien, M. and A.F. Beaubien, (1995): "Design and Performance of a narrow band global UV-B

Radiometer.", Spectrophotometry, Luminescence and Colour; Science and Compliance. C. Burgess and D.G. Jones, eds., Elsevier Science, pp. 415-421.
- Harrison, L., J. Michalsky and J. Bemdt, (1994): "Automated multifilter rotating shadowband radiometer: an instrument for optical depth and radiation measurements.", Applied Optics. 33[22](1994)5118-5125
- Harrison, L. and J. Michalsky (1994): "Objective algorithms for the retrieval of optical depths from ground-based measurements." Applied Optics 33[22](1994)5126-5132
- Michalsky J., J.C. Liljegren and L. Harrison (1995): "A comparison of sun photometer derivations of total column water vapour and ozone to standard measures of same at the Southern Great Plains. Atmospheric Radiation Measurement site", Journal of the Geophysical Research 100[D12](1995)25,995-26,003
- Zhou, C., J. Michalsky and L. Harrison (1995): "Comparison of irradiance measurements made with the multi-filter rotating shadowband radiometer and first-class thermopile radiometers.", Solar Energy 55[6](1995)487-491

Identification number: **2.1.7.4.** [041]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sun photometer, Model SPUV-10 or SPLTV-6. Field instrument to measure direct solar spectral irradiance at six or ten discrete wavelengths from the UVB to the near IR.
2. *First year of operational use*: 1995
3. *Principle of operation*: Each channel is a modular assembly containing a mechanical collimator that precisely limits the direct beam field of view to 2.5 degrees as described by WMO No. 8. A thin-film interference filter in each channel provides highly stable transmission in the passband with steep cutoffs beyond. A solid state photodetector converts radiation not absorbed by tbc filter to a small current. Through the use of Beer's law, optical depth can be derived. To maintain wavelength stability, an internal thermal regulation system is used. The instrument is insulated and environmentally sealed for continuous outdoor use.

Main technical characteristics

4.1 *application*: Column ozone, water vapour, $N0_2$, atmospheric turbidity, aerosol, optical depth, and solar LTV spectrum analysis
4.2 *measuring range*: Wavelengths may be chosen from 300, 305, 311, 317, 325, 332, 368 nm at 2 nm FWHM, and 415, 500, 615, 673, 870, 940 nm at 10 nm FWHM
4.3 *uncertainty*: Linearity < 1%; overall uncertainty < 5%
4.4 *time constant*: 0.1 s
4.5 *averaging time*: 1 s (via YESDAS datalogger)
4.6 *reliability*: Designed for long-term unattended field use
4.7 *interface and output details*: Separate signal and power connectors. Signal: 24-pin Amphenol #165-27 plug with mating connector Amphenol #165-26. Power: 8-pin #165-15 with mating connector #165-14. Both are prewired with a 3-meter cable to YESDAS-2 datalogger.
4.8 *power requirements*: +11 to +14 VDC @ 2 A at startup, dropping to 1 A after instrument has reached 45°C. Also requires -11 to -14 VDC @ 60 mA
4.9 *servicing interval*: Annual calibration
4.10 *other characteristics*:
The instrument is thermally regulated for operation from 50°C to +45°C. Requires manual or automatic solar tracker, sold separately.

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*: US$ 1,995

7. *Name and adress of person responsible for further information*:

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URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
- B.K. Dichter, (1993): "Instrumentation Requirements for Establishing UV Climatology", in Proceedings of the Eighth Symposium on Meteorological Observations and Instrumentation, 17-22 January 1993, Anaheim, CA, Published by the American Meteorological Society, Boston, MA.

Identification number: **2.1.7.5.** [043]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Ultraviolet pyranometer - field instrument to measure total ultraviolet radiation from 280 320 nm (Model UVB-1) and 320 - 480 nm (Model UVA-1).
2. *First year of operational use*: 1992
3. *Principle of operation*: Uses coloured filters and a thermally stabilized UV phosphor that converts incoming radiation to visible light, which is measured by a calibrated, thermally stabilized solid state detector held at 45°C.

Main technical characteristics

4.1	*application*:	Erythemal dose rate studies, ozone depletion, effects of UV on plants, climatological studies
4.2	*measuring range*:	280 to 320 nm (UVB), 320 to 380 (UVA)
4.3	*uncertainty*:	
4.4	*time constant*:	1 s
4.5	*averaging time*:	1 s (when used with YESDAS-2 datalogger)
4.6	*reliability*:	
4.7	*interface and output details*:	0 to 4 VDC, low impedance singled-ended output for each channel; supplied with Amphenol #165-15 weatherproof connector and mating connector #165-14, prewired with 10m Belden cable
4.8	*power requirements*:	-12 V @ 15 mA; +12 V varies with ambient temperature: 120 mA @ +20°C; 500 mA at -40°C
4.9	*servicing interval*:	Annual calibration
4.10	*other characteristics*:	

The instrument is thermally regulated for operation from -40°C to +40°C.

Experiences and other information

5. *Experience from comparisons and tests performed*:
NIST/Colorado/NOAA

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 495

7. *Name and adress of person responsible for further information*:

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

- Dichter, B.K., A.F. Beaubien and D.J. Beaubien (1993): "Development and Characterization of a New Solar Ultraviolet-B Irradiance Detector", J. Atm. Oceanic Tech. 10(1993)337
- Dichter, B.K. (1993): "Fluorescent-Phosphor-Based Broadband LTV Light Sensors", Sensors 10[19](1993).
- Dichter, B.K., D.J. Beaubien (1994): "Ambient Temperature Effects on Broadband LJV-B Measurements Using Fluorescent Phosphor (M9W04)-Based Detectors", in Proceedings of the 1992 Quadrennial Ozone Symposium
- Patent: United States patent, Beaubien et al., Number: 5,331,168, July 19, 1994.

Identification number: **2.1.7.6.** [119]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Model 501 Biometer measures and stores the effective sunburn UV dose. Time and temperature are also stored.
2. *First year of operational use*: 1990
3. *Principle of operation*: A phosphor with an excitation spectrum like the skin sunburn action spectrum emits visible light proportional to the excitation which is then detect detected by a visible Photodiode.

Main technical characteristics

4.1 *application*: Monitor UVB for meteorology, epidemiology and health
4.2 *measuring range*: Peak sensitivity at 294nm, decreases to 0.001 at 333nm
4.3 *uncertainty*: 0.001 minimum sunburn dose per hour
4.4 *time constant*: Dose incremented every second
4.5 *averaging time*: Selectable dose periods 1 to 60 minutes, but usually 30 min.
4.6 *reliability*: With over 400 units in the field, 2-4/year require maint.
4.7 *interface and output details*: 3.5 months of half hourly records. Interfaces to PC, modem and printer
4.8 *power requirements*: 85 to 230 VAC, automatically selected
4.9 *servicing interval*: We suggest annual calibrations, but few users follow the suggestion
4.10 *other characteristics*:
Machined quartz dome, hermetically sealed and temperature stabilized detector. Nitrogen atmosphere and desiccant provide shelf-stable conditions. Except when snow covers, operation unaffected by weather. Response linear to within the noise level of 0.001 minimum sunburn doses. A few meters returned malfunctioned because of broken domes or saturated desiccant. Six meters have been affected by lighting. Eight calibrations here and information from users indicate stability per year is usually within calibration accuracy of ±6%. Measurements stored every second in short term memory and selectable put into normal memory every 1 to 60 minutes. That memory holds over 5K records with time and temperature noted. Downloads to printer, CP or into modem.

Experiences and other information

5. *Experience from comparisons and tests performed*:
The 501 has compared well to calculations and to measurements with spectroradiometers (Jokela K, et.al Photochem & Photobiol. 58, 559,[93])

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 400 + shipping (calibration)

7. *Name and adress of person responsible for further information*:

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Telefax: +215/927-6347
E-mail: sberger@solar.com
URL: http://www.solar.com

8. *Major bibliographic references, applicable patents, etc.:*
- Leszczynski, K. et al (1993): "Performance tests of two RB UV Meters...", International Symposium, Tromsø, 1993
- Jokela, K. et al (1993): "Effects of artic ozone ...", Photochem & Photobiol 85(1993)
- Morys M., D. Berger (1993): "The accurate measurement ...", Intern. Symposium, Tromsø, 1993
- Grainger, R. et al (1993): "UVB R-B meter field calibration", NZ Met. Soc., Wellington, 1993
- Berger, D. (1976): "The sunburn UV meter ...", Photochem & Photobiol 24(1976)
- Barton, I. (1983): "The Australian UVB monitoring network" CSIRO, Tech. Paper, 46(1983).

Identification number: **2.1.7.7.** [124]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* GUV-5611C Ground-based Ultraviolet Radiometer System. Ideal for long-term UV monitoring, or as surface reference for the PUV-500B. It is temperature-controlled and measures 5 channels or surface UV irradiance at 305, 320, 340, 380 nm and PAR (400-700 nm). Components: GUV-511, AC-powered deckbox, 50 m cable (GSC-511/50), and Windows-based software.
2. *First year of operational use*: < 1997
3. *Principle of operation*: Moderate Band Filter, photo detector based light meter for optimizing measurements of Solar irradiance in the UV spectrum.

Main technical characteristics

4.1	*application*:	UV irradiance measurements and Ozone measurements
4.2	*measuring range*:	Surface UV radiance at 305, 320, 340, 380 nm and PAR (400.700)
4.3	*uncertainty*:	Cal-accuracy ~2%
4.4	*time constant*:	continuous
4.5	*averaging time*:	Adjustable range greater than one second to one day
4.6	*reliability*:	Excellent
4.7	*interface and output details*:	RS-232 serial; output, multi-spectral irradiance
4.8	*power requirements*:	Universal AC
4.9	*servicing interval*:	Annual calibration
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Bausch & Lomb UV network, Chile, Argentina, Norway, NOAA and SBIR instrument comparisons.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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Telefax: 619-686-1887
E-mail: jessh@biospherical.com
URL: http://www.biospherical.com

8. *Major bibliographic references, applicable patents, etc.:*
-Booth, C.R., T. Mostechkina, and J. H, Morrow (1994): "Errors in the reporting of solar spectral irradiance using moderate bandwidth radiometers: An experimental investigation", 654/SPIE Vol. 2258 Ocean Optics XII (1994).
- Walker, J.H., R.D. Saunders, J.K. Jackson, end D.A. McSparron 1987): "Spectral Irradiance Calibrations", NBS Special Publication 250-20, U.S. Department of Commerce, 1987.
- "Lowtran", US Air Force Geophysics Laboratory, Hanscom AFB, Mass 01731-5000.

Identification number: **2.1.7.8.** [187]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Thermopile pyranometer and automated tracking sunshine recorder
2. *First year of operational use*: 1996
3. *Principle of operation*: The instrument consists of a thermopile pyranometer and a sunshine recorder based upon pyrheliometric method, and processes the data of global radiation and sunshine duration simultaneously

Main technical characteristics

4.1 *application*: Automatic measurement of global radiation and sunshine duration at manned surface station
4.2 *measuring range*: Global radiation: 0 to 1.5 kW/m^2, Sunshine duration: On (≥ 0.12 kW/m^2) or Off
4.3 *uncertainty*: Global radiation: ±0.5 %, Sunshine duration:±10% (at 0.12kW/m^2)
4.4 *time constant*: Global radiation: 18 s, Sunshine duration: 30 s
4.5 *averaging time*: N/A
4.6 *reliability*:
4.7 *interface and output details*: RS232C
4.8 *power requirements*: 24 VDC, 1 A
4.9 *servicing interval*: Every week
4.10 *other characteristics*:
The opening half-angle of the sunshine recorder is 5° and its slope angle is 1°

Experiences and other information

5. *Experience from comparisons and tests performed*:
The sensor is compared with the JMA's standard pyranometer and pyrheliometer every 5 years.

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

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.7.9.** [188]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Automated measuring for direct solar radiation
2. *First year of operational use*: 1992
3. *Principle of operation*: The pyrheliometer based upon thermopile is mounted on the reliable solar tracker automatically controlled by computer.

Main technical characteristics

4.1	*application*:	Automatic measurement of direct solar radiation at manned surface station
4.2	*measuring range*:	0 to 1.4 W/m^2
4.3	*uncertainty*:	±1%
4.4	*time constant*:	7 s (response time 95%)
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	RS232C
4.8	*power requirements*:	100 VAC, 50/60 Hz
4.9	*servicing interval*:	Calibrated by the National Standard every five years
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
The instrument is calibrated with the National Standard every five years

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 850

7. *Name and adress of person responsible for further information*:

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Telefax: +81 3 3211 2032
E-mail: inad-jma@hq.kishou.go.jp
URL: http://

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

Identification number: **2.1.7.10.** [203]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* BW100 - UVB Radiation sensor
2. *First year of operational use*: 1994; Cooperate development with private industry (Vital Technologies Inc., Bolton, Ontario, Canada). - Experimental Network
3. *Principle of operation*: UV-B radiation measured using special filters, a photodiode, and processing electronics.

Main technical characteristics

4.1 *application*: Radiation measurements
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 VDC
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 completed. Some units are still being used operationally. Company no longer exists.

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

7. *Name and adress of person responsible for further information*:
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8. *Major bibliographic references, applicable patents, etc.:*
Proprietary product of Vital Technologies Ltd., Bolton, Ontario, Canada. Company has been closed.

Other entries related to this category:

1.1.02.2	2.1.02.26
1.1.02.4	2.1.02.27
1.2.03.1	2.1.02.28
2.1.02.11	2.1.02.29
2.1.02.14	2.1.02.30
2.1.02.22	2.1.05.12
2.1.02.23	2.1.15.3
2.1.02.24	2.2.01.7
2.1.02.25	2.2.01.8

Identification number: **2.1.8.1.** [026]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sensor and display-power supply for the measurement of sunshine duration
2. *First year of operational use*: 1997
3. *Principle of operation*: Glass fibers in a rotating disk transport light to a photo-cell. When the voltage generated in the photo-cell is above a certain value, the light is detected as "sunshine".

Main technical characteristics

4.1 *application*: Health, agriculture, research, etc.
4.2 *measuring range*: Instrument switches at 120 W/m^2
4.3 *uncertainty*:
4.4 *time constant*: Instant response
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Output of sensor: Pulse of 120 mV
output of counter: 8 A, 250 VAC relais
4.8 *power requirements*: 220 VAC, 50 Hz. Power consumption: < 5 W
4.9 *servicing interval*: Glass dome needs to be cleaned every few weeks
4.10 *other characteristics*:
Model 515/815 sunshine duration sensor catches sunlight from all angles by means of a rotating measuring disk. Above a certain intensity (corresponding to a radiation intensity of 120 W/m^2) a counter switches on and registrates total sunshine duration.

Experiences and other information

5. *Experience from comparisons and tests performed*:
The instruments have been running for over a year with good results

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

7. *Name and adress of person responsible for further information*:

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Handelskade 76
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URL: http://

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

Other entries related to this category:

1.1.07.6
1.1.07.7
1.1.07.8
2.1.07.2
2.1.07.3
2.1.07.7
2.1.07.8

2.1.9. Measurement of visibility

Identification number: **2.1.9.1.** [010]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Type CNR 1 Net radiometer. Four components: 2 solar (type CM3)+ 2 far infrared FIR (type CG3)
2. *First year of operational use*: 1995
3. *Principle of operation*: Four separate broadband sensors: Incoming & reflected solar & far IR, with heating to avoid dew deposition.

Main technical characteristics

4.1 *application*: Radiation: Energy balance study
4.2 *measuring range*: 0.3 to 3 μm for solar CM3, 5 to 50 μm for far infrared CG3
4.3 *uncertainty*: ±10% for daily totals
4.4 *time constant*: 18 s
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Voltage: 0 to 50 mV (CM3), -25 to +25 mV (CG3)
4.8 *power requirements*: Heating: 6 W
4.9 *servicing interval*: Weekly
4.10 *other characteristics*:
Very robust & reliable compared to conventional plastic dome instruments

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent

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

7. *Name and adress of person responsible for further information*:
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Telefax: +31 (0)15 262 0351
E-mail: kippmain@pi.net
URL: http://

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

Identification number: **2.1.9.2.** [011]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Sky Radiometer "PREDE" POM-01L. Direct and scattered solar radiation in well defined angular positions & spectral bands.
2. *First year of operational use*: 1995
3. *Principle of operation*: Photodiode detection, filter set for special bands, tracking device for angular movement.

Main technical characteristics

4.1 *application*: Climatological research of the radiation budget
4.2 *measuring range*: 315, 400, 500, 675, 870, 940, 1020 nm
4.3 *uncertainty*:
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: RS232
4.8 *power requirements*: 100/220 V AC; 2 A
4.9 *servicing interval*: Weekly
4.10 *other characteristics*:
the main advantage is that the instrument is calibrated, using its own measured data. This is achieved using the sun as a calibration source.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent performance.

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

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.1.9.3.** [012]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Net radiometer NR-LITE: Total radiation balance.
2. *First year of operational use*: 1997
3. *Principle of operation*: One differential thermal measurement, combined with two black absorbers.

Main technical characteristics

4.1	*application*:	Agricultural meteorology, building physics and road safety.
4.2	*measuring range*:	-2000 to +2000 W/m^2 (0.3-3.0-30 μm)
4.3	*uncertainty*:	
4.4	*time constant*:	1/e: 20 s nominal
4.5	*averaging time*:	
4.6	*reliability*:	N/A
4.7	*interface and output details*:	Voltage output, e.g. -25 to +25 mV
4.8	*power requirements*:	No power requirements
4.9	*servicing interval*:	Weekly
4.10	*other characteristics*:	

The instrument is designed for low maintenance

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent

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

7. *Name and adress of person responsible for further information*:

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E-mail: kippmain@pi.net
URL: http://

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

Identification number: **2.1.9.4.** [116]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Handar 470 Visibility Sensor is a microprocessor based forward scatter instrument that measures from 0.019 to 37 miles.

2. *First year of operational use*: 1991

3. *Principle of operation*: The 470 sensor projects a pulse beam of infrared light into a sample volume of air. Aerosols in the sample volume scatter the light, and the receiver head detects the light scattered forward 30° to 40° off the beam axis. The amount of light scattered forward is proportional to the atmospheric extinction coefficient. Visibility is calculated using the extinction coefficient. The algorithm used for daytime visibility differs from that of nighttime visibility. Therefore, a Day/Night sensor is used to sense the illumination of surroundings.

Main technical characteristics

4.1 *application*: Automatic Met Stations; Aeronautical Met Stations; Autonomous Visibility applications

4.2 *measuring range*: Visibility: 0.019 to 37 miles; extinction coefficient: 0.05 to 100/km

4.3 *uncertainty*: ± 0.02/km ± 5% in comparison to factory standard meter
± 15% RMSE in comparison to transmissometer

4.4 *time constant*: 0.1 seconds

4.5 *averaging time*: Averaging done in data collection platform or PC

4.6 *reliability*: Calculated MTBF (MIL-HDBK-217D): > 10 years

4.7 *interface and output details*: Text via RS 232: extinction coefficient and daytime visual range DC voltage and Frequency: extinction coefficient; Day/Night sensor: voltage

4.8 *power requirements*: 470A: 120/240 VAC; 50/60 Hz
470B: 12 VDC, 250 mA; no heaters

4.9 *servicing interval*: Window cleaning: as needed. Calibration and sensor check: semi-annual

4.10 *other characteristics*:
1. Internal keypad and LED display for local readings and maintenance/calibration routines.
2. Window condition is monitored and 470 processor automatically corrects the extinction coefficient based on the measured contamination of the windows.
3. Field calibration is done using a diffuser type attenuator and zero plug. Because of the ability of the sensor to monitor window contamination and correct the extinction coefficient, the calibration interval required is semi-annual.
4. Sensor certified compliance with EMI requirements based on FCC Part 15, Subpart J Class A for radiated and power line conducted ratio test.
5. Service Life is 20 years.
6. Extensive tests performed on the transmitter and receiver for use in the FAA Runway Visual Range program.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Certified for use in AWOS systems: Handar and AAI NEXWAS; Certified for use in the FAA Runway Visual Range program through Teledyne Controls; Qualification testing in the Idaho Storm Warning Intelligent Vehicle Highway System; yearly evaluations performed by State of Minnesota Dept. of Transportation AWOS program office; extensive environmental testing performed at OTIS Air National Guard Base.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:
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E-mail: marketing@handar.com
URL: http://www.handar.com

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

Identification number: **2.1.9.5.** [139]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The FD12 measures visibility.
2. *First year of operational use*: 1989
3. *Principle of operation*: The FD12 uses forward scatter measurement principle. Build-in compensation for different types of precipitation.

Main technical characteristics

4.1	*application*:	MOR measurement for airports, weather stations, high ways
4.2	*measuring range*:	Visibility 10 to 50 000 m
4.3	*uncertainty*:	Variability between units ± 4 %, Signal stability ± 2 % (scatter measurement repeatability)
4.4	*time constant*:	N/A
4.5	*averaging time*:	1 min 10 min
4.6	*reliability*:	MTBF (predicted) > 12 000 hours
4.7	*interface and output details*:	RS232 / RS485, 300 Bd FSK Modem
4.8	*power requirements*:	35 W + 100 W for hood heaters
4.9	*servicing interval*:	Window cleaning and calibration every six months or more often depending on location

4.10 *other characteristics*:
Field calibration can be carried out in practically any weather conditions using a calibration kit. Extensive self diagnostics monitors continuously the status of the sensor. Excessive contamination or lens blockage are detected automatically

Experiences and other information

5. *Experience from comparisons and tests performed*:
Numerous tests and evaluations has been carried out. Please refer to extended product version FD12P questionnaire.

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
- Performance data of Vaisala FD12 visibility sensor for use in AWOS in compliance with FAA advisory circular AC150/5220-16A , 1991 (not published).
- Mousset, G. et.al. (1994): "Assessment of Visibility Meters", Meteo France SETIM internal report no. 6, 1994
- Korhonen, O. and M. Eteläpää (1994): "Näkyvyys-sirontamittari vastaan Transmissiometri", Finnish Civil Aviation Administration internal report , 1994
- Andersen, L. and P. Kjensli (1994): "Intercomparison of Visibility Instruments at Oslo Airport-Gardemoen", DNMI internal report, 1994

Identification number: **2.1.9.6.** [140]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The CT75K Lidar Ceilometer is used for backscatter profiling and cloud detection through the atmosphere. The CT75K gives a range normalized backscatter profile up to 75 000 ft. It also reports cloud heights up to three cloud layers and gives an estimation of vertical visibility in certain weather conditions.
2. *First year of operational use*: 1996
3. *Principle of operation*: The CT75K employs pulsed diode laser LIDAR (Light Detection and Ranging) technology. The CT75K operates four optical transceivers of the CT25K in parallel.

Main technical characteristics

4.1	*application*:	Airports, Weather station, Test grounds, Meteorological and Astronomical observatories etc.
4.2	*measuring range*:	Half range mode : 0 to 37 500 ft (0 to 11.2 km) Full range mode : 0 to 75 000 ft (0 to 22.5 km)
4.3	*uncertainty*:	± 2 % ± 1/2 [resolution]
4.4	*time constant*:	N/A
4.5	*averaging time*:	Half range mode : 30 s, Full range mode : 60 s
4.6	*reliability*:	Data not available
4.7	*interface and output details*:	Two serial lines, RS232, RS485; Modem 2400 bits/s
4.8	*power requirements*:	max. 900 W including heating
4.9	*servicing interval*:	Window cleaning and status message check at regular intervals

4.10 *other characteristics*:
First series produced lidar. This makes it affordable. New coaxial single lens optics, which is self aligning and requires no field adjustments. CT75K has extensive internal monitoring. Comprehensive set of user commands can be given locally or remotely. Modular design of the CT75K makes the troubleshooting and service easy and cost effective.

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 adress of person responsible for further information*:

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

- Kähkönen, T. and J. Lönnqvist (1996): "A New High-altitude Lidar Ceilometer for 75,000 ft. measurement", AMS Twelfth International Conference on Interactive Information and Processing Systems, Jan. 28- Feb. 2, Atlanta, Georgia, 1996
- Kähkönen, T. and J. Lönnqvist (1996): "New High-Altitude Lidar Ceilometer for Measurements up to 75,000 ft.", Vaisala News, No 139, 1996
- Kärkkäinen, A., A. Piironen, T. Kähkönen and J. Lönnqvist (1997): "The Characteristics and Performance of Vaisala's New CT75K Lidar Ceilometer", Lidar Atmospheric Monitoring, 16-18 June, 1997

Patents:

- Measurement system for scattering of light, US Patent No 5,116,124, May 26, 1992
- Method and apparatus for measuring meteorological visibility and scattering of light, said apparatus utilizing common optics for transmission and reception, US Patent No. 5,504,577, Apr.2,1996; Patented also in several other countries.

Identification number: **2.1.9.7.** [141]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The CT25K Laser Ceilometer is a cloud height sensor. The CT25K reports cloud heights up to three cloud layers and an estimation of vertical visibility in certain weather conditions. Sky condition information, cloud amount and cloud layer heights, is also available as option.
2. *First year of operational use*: 1995
3. *Principle of operation*: The CT25K employs pulsed diode laser LIDAR (Light Detection and Ranging) technology. The Sky Condition algorithm is developed from Larsson algorithm.

Main technical characteristics

4.1	*application*:	Airports, Weather station
4.2	*measuring range*:	0 to 25 000 ft (0 to 7.5 km)
4.3	*uncertainty*:	± 2 % ± 1/2 [resolution]
4.4	*time constant*:	N/A
4.5	*averaging time*:	Cloud height : 12 seconds, Sky Condition : 30 minutes
4.6	*reliability*:	Data not available
4.7	*interface and output details*:	Two serial lines, RS-232, RS-485, Modem Bell/CCITT 300 to 2400 bits/s
4.8	*power requirements*:	max. 430 W including heating
4.9	*servicing interval*:	Window cleaning and status message check at regular intervals

4.10 *other characteristics*:
New coaxial single lens optics, which is self aligning and requires no field adjustments. Because of beam overlap and hence reduced sensitivity to multiple scatter, the CT25K performs better in precipitation and fog. CT25K has extensive internal monitoring. Comprehensive set of user commands can be given locally or remotely. Modular design of the CT25K makes the troubleshooting and service easy and cost effective.

Experiences and other information

5. *Experience from comparisons and tests performed*:
   1. Evaluation du telemetre Vaisala CT25K, Meteo France, 30/09/1996
   2. Performance evaluation of Vaisala ceilometer CT25K for meeting FAA advisory circular AC150/5220-16B requirements (not published).

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*: Negligible

7. *Name and adress of person responsible for further information*:

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URL: http://www.vaisala.com

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

Bibliographic references:

- Kärkkäinen, A., J. Lönnqvist and M. Kettunen (1995): "Laser ceilometer newly developed in Finland incorporates an innovative optical design", ICAO Journal 50[8](1995)
- Lönnqvist, J. (1995): "Innovative design based on LIDAR technology", Vaisala News, No 135, 1995
- Lönnqvist, J. (1995): "Experiences with a Novel Single -lens Cloud Height Lidar", AMS Sixth Conference on Aviation Weather Systems, Jan. 15-20, 1995, Dallas, Texas
- Lönnqvist, J. (1996):"Better cloud base detection", Airport Technology International, 1996

Patents:

- Measurement system for scattering of light, US Patent No 5,116,124, May 26, 1992
- Method and apparatus for measuring meteorological visibility and scattering of light, said apparatus utilizing common optics for transmission and reception, US Patent No. 5,504,577, Apr.2,1996
- Patented also in several other countries.

Identification number: **2.1.9.8.** [183]
Country: **Australia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* FD12 Vaisala visibility meter measures meteorological visibility
2. *First year of operational use*: 1995
3. *Principle of operation*: Vis. meter transmits infrared light pulses and detects the light scattered by airborne particles. Intensity of the received pulse is converted via an algorithm to a measure of visibility.

Main technical characteristics

4.1	*application*:	Measuring visibility
4.2	*measuring range*:	Measures forward scatter firm ~ 1 litre of air
4.3	*uncertainty*:	Not defined
4.4	*time constant*:	15 s
4.5	*averaging time*:	Instantaneous
4.6	*reliability*:	OK
4.7	*interface and output details*:	RS232C, RS485, CCITT V.21 (modem interfaces): Digital output.
4.8	*power requirements*:	240 VAC
4.9	*servicing interval*:	Clean lenses every 6 months or more often in "dirty" environments
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
No tests carried out

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	~ US$ 1,450

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.1.9.9.** [189]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Runway Visual Range observation equipment
2. *First year of operational use*: 1992
3. *Principle of operation*: The Runway Visual Range (RVR) is calculated from Extinction Coefficient (EC) which is estimated by a visibility sensor, Background Luminance (BGL) which is measured by ambient light sensor and Runway Light setting (L/S) or Centerline Runway Light Setting (C/S) which is obtained from the Civil Aviation Bureau. Meteorologic (MOR) is calculated from Extinction Coefficient (EC) which is estimated by a visibility sensor.

Main technical characteristics

4.1	*application*:	Automatic measurement of MOR or RVR at manned aviation weather station
4.2	*measuring range*:	EC: 0.3 to 0.0003 /m, BGL: 3 to 12000 cd/m^2, MOR: 10 m to 10 km, RVR: 50 to 1800 m
4.3	*uncertainty*:	MOR (10 m to 10 km), ±10%
4.4	*time constant*:	15 s (sampling interval)
4.5	*averaging time*:	1 min
4.6	*reliability*:	
4.7	*interface and output details*:	RS232C
4.8	*power requirements*:	transmitter, receiver: 100 VAC, 300 VA, processor: 100 VAC, 200 VA.
4.9	*servicing interval*:	Every week
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$ 5,000

7. *Name and adress of person responsible for further information*:

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

Other entries related to this category:

1.1.02.4 2.1.07.2
1.1.07.6 2.1.07.3
2.1.02.15
2.1.02.17
2.1.06.6
2.1.06.7

Identification number: **2.1.10.1.** [014]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* An automatic sensor which measures the rise and fall of water in a standard evaporation pan and provides a digital output of the level.
2. *First year of operational use*: 1993
3. *Principle of operation*: A float drives an optical code strip which produces an output in quadrature. Each count is equal to 0.25 mm

Main technical characteristics

4.1 *application*: Automatic measurement of evaporation
4.2 *measuring range*: 0 - 15 cm
4.3 *uncertainty*: ±0.25 mm
4.4 *time constant*: instantaneous
4.5 *averaging time*: N/A
4.6 *reliability*: excellent
4.7 *interface and output details*: RS232 or 4 - 20 VDC or 0 - 10 VDC
4.8 *power requirements*: 5 - 24 VDC
4.9 *servicing interval*: seasonal (12 months)
4.10 *other characteristics*:
Material: Stainless steel and PVC
Range: 0 - 15 cm, Resolution: 0.25 mm, Accuracy: ±0.25 mm.
Transducer: Optically coupled float with quadrature output. Built in level.

The advantage of this sensor is the accuracy of the digital output, the elimination of manual reading. The sensor may also be equipped with a totalizing anemometer and a water temperature probe.

Experiences and other information

5. *Experience from comparisons and tests performed*:

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

7. *Name and adress of person responsible for further information*:
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25 Federal Street, Box 443
Bar Harbor, Maine 04609
USA

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Telefax: 207-288-3477
E-mail: sales@rainwise.com
URL: http://www.rainwise.com

8. *Major bibliographic references, applicable patents, etc.:*
- U.S. General Service Administration Catalog #66-410F
- U.S. Patent # 5,245,874

Other entries related to this category:

1.1.02.2 2.1.14.2
1.1.04.1 2.2.01.7

2.1.11. Measurement of soil moisture

- none -

Other entries related to this category:
1.1.04.1

2.1.12. Measurement of upper air pressure, temperature, humidity

Identification number: **2.1.12.1.** [020]
Country: **Kuwait**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* VIZ W9000 PTU + Gematronic Windfinding Radar, combined to measure upper wind, temperature, humidity in case of Omega termination
2. *First year of operational use*: 1997
3. *Principle of operation*: Processing PTU signal with radar signal

Main technical characteristics

4.1	*application*:	Processing PTU
4.2	*measuring range*:	Surface to 30 km
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	Serial interface Sp: 1200, D.B.7, parity: Even.
4.8	*power requirements*:	240 VAC
4.9	*servicing interval*:	Yearly
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
The new system is operating very good (PTU Radar) for upper air data, compared to the vaisala radiosonde using the Omega signal (after comparison and test performed regularly)

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 300 Daily (Note: "Use as stand-by system")

7. *Name and adress of person responsible for further information*:

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URL: http://www.kuwait.net/~aviation

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

Identification number: **2.1.12.2.** [133]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* RS80 family of radiosondes for measurement of upper air profiles of pressure, temperature, humidity and winds. RS80 sondes are with 400 MHz or 1680 MHz transmitter, in either wide or narrow bandwidth versions. Several wind measurement alternatives are available, such as GPS, Loran-C, Communications VLF or RDF. Special sensors for radioactivity and ozone measurement can be add

2. *First year of operational use*: 1979 Release of RS80 family (Omega etc.); 1996, with GPS wind finding capability, RS80-15G

3. *Principle of operation*: A radiosonde flies with a hydrogen or helium balloon. The measurements of capacitive temperature, humidity and pressure sensors are transferred by 400 MHz or 1680 MHz transmitter to the dedicated ground receiver and computation system. NAVAID windfinding methods relay on a VLF radiosonde receiver for Loran-C or Alpha and Communications VLF networks. A GPS radiosonde receiver measures L1 carrier shift frequencies (Doppler's) of Global Positioning System (GPS) satellites. The third windfinding alternative RDF is passive and based on radiosonde transmission (1680 MHz). A water-activated battery provides power for the radiosonde.

   The optional Vaisala NSS14 radioactivity sensor is interfaced to Vaisala Radiosondes for measuring the atmospheric profile of radioactivity. Radiation is measured with two Geiger-Müller detectors: the other detector is sensitive to γ-radiation, whereas the other measures both γ- and β-radiation.

   An electrochemical ozone sensor can be interfaced to RS80 radiosondes. For example an ECC-6A sensor, manufactured by Science Pump Corporation, detects ozone on the basis of iodine-iodide redox reaction.

Main technical characteristics

4.1	*application*:	Upper air observations
4.2	*measuring range*:	Pressure:1060 hPa to 3 hPa Temperature: +60°C to -90°C Humidity: 0 to 100 %RH Wind: 0 to 180 m/s Radioactivity (dose rate): 0.1 to 60 mR/h (γ-channel), 0.4 to 120 mR/h (β-channel) Ozone: 0 to 30 mPa ozone partial pressure
4.3	*uncertainty*:	Pressure: reproducibility in sounding 0.5 hPa, repeatability of calibration 0.5 hPa Humidity: reproducibility in sounding < 3 %RH, repeatability of calibration 2 %RH Temperature: reproducibility in sounding 0.2 °C up to 50 hPa, 0.3 °C for 50 -15 hPa, 0.4 °C above 15 hPa; repeatability of calibration 0.2 °C Wind: GPS (fixed station, PDOP < 4) 0.2 m/s RMS, GPS (moving station, PDOP < 4) 0.5 m/s RMS; Loran 1.0 m/s; Comm-VLF 5.0 m/s. Radioactivity: less than ± 10% of indicated value Ozone: less than ± 10% of indicated value (ECC-6-A by SPC)
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	
4.8	*power requirements*:	Water-activated 19 V battery
4.9	*servicing interval*:	N/A (Radiosonde is typically used for 3 hours).
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
   WMO International Radiosonde Comparison Phases I, II, III, IV (WMO/TD no 195, 451 and 742)

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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Finland

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Telefax: +358 9 894 9210
E-mail: hannu.kankaanpaa@vaisala.com
URL: http://www.vaisala.com

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

Identification number: **2.1.12.3.** [136]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Dropsonde RD93
2. *First year of operational use*: 1997
3. *Principle of operation*: Thin film capacitive humidity sensor, Silicon aneroid capacitive pressure sensor, Ceramic bead capacitive temperature sensor, GPS, Doppler information for wind measurement

Main technical characteristics

4.1 *application*: Observations over oceans, severe storm tracking
4.2 *measuring range*: from 24 km down to sea level
4.3 *uncertainty*: like radiosondes
4.4 *time constant*: 1.5 s
4.5 *averaging time*: instant measurements
4.6 *reliability*: 90 %
4.7 *interface and output details*: DROP TEMP
4.8 *power requirements*: N/A
4.9 *servicing interval*: N/A
4.10 *other characteristics*:
Instrument is dropped from an aircraft and it descents with a parachute transmitting signals which are received in the aircraft

Experiences and other information

5. *Experience from comparisons and tests performed*:
NOAA dropped 90 dropsondes during one hurricane tracking flight with near 100% success.

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

7. *Name and adress of person responsible for further information*:

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Telefax: +358 9 894 9210
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URL: http://www.vaisala.com

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

Identification number: **2.1.12.4.** [171]
Country: **Singapore**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Automated upper-air sounding system for measurements of upper air pressure, temperature, humidity and wind as well as vertical distribution of ozone
2. *First year of operational use*: 1996
3. *Principle of operation*: The ground receiving and processing system tracts a radiosonde with a GPS receiver as it is lifted through the atmosphere by balloon

Main technical characteristics

4.1	*application*:	Pressure, temperature, humidity, Wind speed/direction
4.2	*measuring range*:	P: 1060 to 3 hPa, T: +60 to -90°C, U: 0 to 100%RH, FF: 0 to 180 m/s, DD: 1 to 360°
4.3	*uncertainty*:	P: 0.5 hPa, T: 0.2 to 0.4°C, U: 3%RH, FF: 0.2 to 1.0 m/s (vector)
4.4	*time constant*:	On average, 1.5 s
4.5	*averaging time*:	N/A
4.6	*reliability*:	
4.7	*interface and output details*:	RS232, with ASCII & CCITT-2
4.8	*power requirements*:	220 VAC and 24 VDC
4.9	*servicing interval*:	Preventive maintenance is carried out monthly while diagnostic programs are run every week.
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Initially there was some data loss as a result of interference caused by rain at the station.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 180,000

7. *Name and adress of person responsible for further information*:

Mr Tian-Kuay Lim
Meteorological Service Singapore
Changi Airport Post Office
P 0 Box 8
Singapore 918141
Republic of Singapore

Telephone: (65) 5422863
Telefax: (65) 5457192
E-mail: lim_tian_kuay@mss.Gov.Sg
URL: http://

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

Identification number: **2.1.12.5.** [190]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* TYPE RS2-91 Radiosonde: Measurement of atmospheric pressure, temperature, humidity and wind.
2. *First year of operational use*: 1992
3. *Principle of operation*: The radiosonde observes upper winds with the radio theodolite system. The sonde uses the capacitive aneroid capsule, rod thermistor and capacitive thin polymer film element for observing pressure, temperature and humidity, respectively.

Main technical characteristics

4.1 *application*: Upper air observations
4.2 *measuring range*: P: 1050 to 5 hPa, T: +40°C to -90°C, U: 0 to 100%RH
4.3 *uncertainty*: P: ±1 hPa, T: ±0.5°C, U:±7%RH (10 to 95%RH), ± 10%RH (O to 1O%RH, 95 to 100%RH)
4.4 *time constant*: T: < 2 s, U: < 1 sec (under 6 m/s wind at ground)
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*:
4.8 *power requirements*: 15 VDC, 150 mA
4.9 *servicing interval*: Used one time only
4.10 *other characteristics*:
ITU-Remission type: A1D, Carrier frequency: 1673, 1680, 1687 MHz, Modulation frequency: 0 to 4000 Hz, Dimension: 100×95×180(mm), Weight: about 250g, including a battery

Experiences and other information

5. *Experience from comparisons and tests performed*:
The radiosonde was compared with other radiosondes participated in the WMO International Radiosonde comparison held in Tukuba, Japan from 15 Feb. to 12 Mar. 1993.

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

7. *Name and adress of person responsible for further information*:

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Japan Meteorological Agency
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Tokyo 100
Japan

Telephone: +81 3 3211 4966
Telefax: +81 3 3211 2032
E-mail: inad-jma@hq.kishou.go.jp
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
WMO/TD-No.79; WMO International Radiosonde Intercomparison Phase IV (1996)

Identification number: **2.1.12.6.** [197]
Country: **Mexico**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Automatic radiosonde stations (Vaisala MW11). Variables being measured: Temperature, relative humidity, pressure, high level wind direction and speed
2. *First year of operational use*: 1992
3. *Principle of operation*: High level data acquisition system through the follow up of radiosondes with OMEGA & VLF systems. Data transmission via satellite or radio

Main technical characteristics

4.1 *application*: Prediction, air navigation, meteo & climate
4.2 *measuring range*: temperature: +60 to -90°C; relative humidity: 0 to 100%RH, pressure: 1060 to 5 hPa
4.3 *uncertainty*: Temperature: 0.1°C, Relative Humidity: 2%RH, Pressure: 0.1 hPa
4.4 *time constant*: From 1 to 5 min after launching: Every 10 s; from 5 to 15 min: every 30 s; from 15 min till bursting: every minute.
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: Electrical signal of sensors related to variation of magnitude of variable being measured. Digicora sampling, digitizing, processing, archiving & transmitting in TEMP messages.
4.8 *power requirements*: Source from 90 to 135 V, 55 to 65 Hz
4.9 *servicing interval*: 3 to 6 months in dry locations due to dust deposits. For other stations: Every 6 months.
4.10 *other characteristics*:
Data archiving capacity: Equipped with 2 drives for back-up of each sounding in ASCII or binary format. Communication: Via satellite or radio. Maintenance: Batteries, main processor needs to be cleaned. Processing capabilities: Dew point temperature, wind speed & direction. Sensor characteristics: Humidity - Hygristor, Temperature - Capacitor, Pressure - Aneroid capsule. Stations installed: 10

Experiences and other information

5. *Experience from comparisons and tests performed*:
Often data are lost at any height when precipitation occurs

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 160,000 (per station)

7. *Name and adress of person responsible for further information*:

Ing David Esparza Villasana
National Meteorological Service
Av. Observatorio No. 192
Col. Observatorio
11860 Mexico, D.F.
Mexico

Telephone: 6 26 87 98
Telefax: 6 26 86 95
E-mail: desparza@smn.cna.gob.mx
URL: http://

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

Other entries related to this category:
1.1.02.4
1.1.04.1

2.1.13. upper wind

Identification number: **2.1.13.1.** [057]
Country: **South Africa**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Measurement of barometric pressure + tendency over 3 hours electronically as well as storage of pressure data every 5 minutes in a loose standing unit.
2. *First year of operational use*: 1997
3. *Principle of operation*: Storage of pressure data from a reliable pressure sensor, like vaisala PA11, on own developed storage module. Changed monthly by amateur observer and sent to nearest weather office. This is to replace barograph.

Main technical characteristics

4.1	*application*:	Storing of barometric pressure at 5 minute intervals, and displaying pressure and APPPP continuously
4.2	*measuring range*:	800 to 1060 hPa
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	Very reliable
4.7	*interface and output details*:	Storage module coupled to PC and downloaded when sent to weather office
4.8	*power requirements*:	220 V
4.9	*servicing interval*:	Monthly to change module
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
As accurate as Vaisala pressure sensor PA11

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Postage, observers remuneration

7. *Name and adress of person responsible for further information*:

Mr A. (Riaan) J. Lourens
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Rep. of South Africa

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Telefax: (012) 6651594
E-mail:
URL: http://

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

Identification number: **2.1.13.2.** [100]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Low cost barometric pressure transducer
2. *First year of operational use*: 1995
3. *Principle of operation*: Variable capacitance of ceramic plates (gold plated)

Main technical characteristics

4.1	*application*:	Barometric pressure
4.2	*measuring range*:	0 to 20 psia, 600 to 1100 hPa, 800 to 1100 hPa
4.3	*uncertainty*:	±0.25% FS
4.4	*time constant*:	< 10 ms
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	1/8" push on tubing, 0.5 to 4.5 VDC output
4.8	*power requirements*:	5, 12, 24 VDC; < 0.2 W
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 adress of person responsible for further information*:

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159 Swanson Rd.
Box Boro, MA 01719
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Telefax: 508-264-0292
E-mail: larouco@setra.com
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Patent Nos. 4168518, 4054833

Identification number: **2.1.13.3.** [157]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PTB220 series digital barometers: atmospheric (surface) pressure
2. *First year of operational use*: 1995
3. *Principle of operation*: - uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - microprocessor electronics performing high order linearization and thermal compensation
   - capable of calculating not only prevailing pressure but also three-hour trend and tendency (0...8)

Main technical characteristics

4.1 *application*: measurement of atmospheric (surface) pressure
4.2 *measuring range*: 500 to 1100 hPa abs. / -40 to +60°C
4.3 *uncertainty*: ±0.01% reading / ±0.10 hPa / ±0.2 hPa / ±0.3 hPa
4.4 *time constant*:
4.5 *averaging time*: 1 to 60 s
4.6 *reliability*: MTBF 10 years
4.7 *interface and output details*: RS232C /TTL level / RS485 / RS422 serial interface, also secondary pulse/voltage/current output available
external on/off triggering possible
4.8 *power requirements*: 10 to 30 VDC / 25 to 50 mA
4.9 *servicing interval*: 1 to 3 years
4.10 *other characteristics*:
- configurable digital barometer with several options (accuracy classes, number of pressure transducers etc.)
- available with one, two or three internal pressure transducers for redundant measurement
- available with local display for presentation of pressure and three-hour trend and tendency (0 ... 8)
- available with a wooden carrying case and rechargeable battery for portable applications
- automatic readjustment and recalibration of several PTB220 series barometers in one batch is possible
- separate static pressure head must be used to attenuate wind induced errors
- the PTB220 series barometers are rugged and robust units and tolerate any standard transportation

Experiences and other information

5. *Experience from comparisons and tests performed*:
Long-term stability is generally within ±0.1 hPa per year in the field use and typically ± 0.05 hPa per year in room temperature use.

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: (Information not available)

7. *Name and adress of person responsible for further information*:

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URL: http://www.vaisala.com

8. *Major bibliographic references, applicable patents, etc.:*
Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala.

Identification number: **2.1.13.4.** [158]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* PTB100 series analogue barometers: atmospheric (surface) pressure
2. *First year of operational use*: 1994
3. *Principle of operation*: - uses the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala
   - all analogue electronics

Main technical characteristics

4.1	*application*:	measurement of atmospheric (surface) pressure
4.2	*measuring range*:	900 to 1100 hPa / 800 to 1060 hPa / 600 to 1060 hPa / -40 to +60°C
4.3	*uncertainty*:	±0.3 hPa / ±0.5hPa at room temperature; typically ±1 to 2 hPa over the whole temperature range
4.4	*time constant*:	
4.5	*averaging time*:	about 1 s
4.6	*reliability*:	MTBF 10 years
4.7	*interface and output details*:	0 to 2.5 VDC or 0 to 5 VDC, external on/off triggering possible
4.8	*power requirements*:	10 to 30 VDC / 4 mA
4.9	*servicing interval*:	1 to 3 years
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
   Long-term stability is typically ±_0.1 hPa per year in the field use.
6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	(Information not available)

7. *Name and adress of person responsible for further information*:

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URL: http://www.vaisala.com

8. *Major bibliographic references, applicable patents, etc.:*
   Various patents covering the BAROCAP® silicon capacitive absolute pressure sensor of Vaisala.

Identification number: **2.1.13.5.** [192]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Digital Barometer
2. *First year of operational use*: < 1997
3. *Principle of operation*: The instrument uses a silicone micro-machined resonator as a detector.

Main technical characteristics

4.1	*application*:	Automatic measurement of pressure at manned or automatic surface station
4.2	*measuring range*:	From 500 to 1300 hPa
4.3	*uncertainty*:	±0.15 hPa
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	RS232C
4.8	*power requirements*:	12 (10.6 to 16.5) VDC, max. 13.5 mA
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 adress of person responsible for further information*:

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Telefax: 81-284-42-8122
E-mail:
URL: http://

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

Other entries related to this category:

1.1.02.4
1.1.05.3
1.1.12.1
1.1.12.2
1.1.12.3
2.1.05.10
2.1.06.3
2.1.12.2
2.1.12.3
2.1.12.4
2.3.00.4

2.1.14. present and past weather, state of the ground

Identification number: **2.1.14.1.** [091]
Country: **Sweden**

General information

1. *Short identification of the instrument including the parameter measured, or its function:*
   a) Precipitation sensor OPTIC EYE™
   b) Freezing point sensor FRENSOR®
2. *First year of operational use*: a) 1994, b) 1996
3. *Principle of operation*: a) optical beams, b) active measuring, peltier elements

Main technical characteristics

4.1	*application*:	Measurement of precipitation (freezing)
4.2	*measuring range*:	a) mm/h (rain, snow, sleet), b) °C ±0.5°C
4.3	*uncertainty*:	a) 15 to 20 %, ±0.5°C
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	RS232
4.8	*power requirements*:	a) 24 / 12 VDC, b) 12 V
4.9	*servicing interval*:	1 year
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
   a) 600 pcs in use worldwide
   b) world patented, being tested in many countries at the moment

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Very low (automatic sensors)

7. *Name and adress of person responsible for further information*:

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831 25 Östersund
Sweden

Telephone: +46 63 156330
Telefax: +46 63 156301
E-mail: lars.sahlin@enator.se
URL: http://www.enator.se

8. *Major bibliographic references, applicable patents, etc.:*
   FRENSOR®: World patented

Identification number: **2.1.14.2.** [195]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Self-calibrating heat-flux sensor measures heat-flux; auto-calibration
2. *First year of operational use*: 1996
3. *Principle of operation*: Differential temperature measurement with voltage output. During calibration an artificially generated flux is introduced into the measurement.

Main technical characteristics

4.1 *application*: Evapotranspiration
4.2 *measuring range*: -2000 to +2000 W/m^2
4.3 *uncertainty*: ±5%
4.4 *time constant*:
4.5 *averaging time*: N/A
4.6 *reliability*: 100%
4.7 *interface and output details*: Typically operated by datalogging & control system
4.8 *power requirements*: Normal: 0, when calibrated: 6 W
4.9 *servicing interval*: 2 year
4.10 *other characteristics*:
Major error sources like dependence on soil moisture content and temperature dependence are eliminated. The sensor performance is continually under control

Experiences and other information

5. *Experience from comparisons and tests performed*:
Wageningen Agricultural University confirmed accuracy in laboratory

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

7. *Name and adress of person responsible for further information*:

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URL: http://www.box.nl/~heatflux

8. *Major bibliographic references, applicable patents, etc.:*
See www homepage.

Other entries related to this category:

1.1.05.3
1.1.06.2
1.1.10.1
2.1.02.15
2.1.02.17
2.1.06.6
2.1.06.7
2.3.00.4

2.1.15. Observation of clouds

Identification number: **2.1.15.1.** [062]
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 recorder
2. *First year of operational use*: 1997
3. *Principle of operation*: Use of exponential decay algorithms to identify cloud layers and amount

Main technical characteristics

4.1 *application*: Automatic Weather Stations
4.2 *measuring range*: 50 to 24,000 ft
4.3 *uncertainty*:
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*:
4.9 *servicing interval*: Not required
4.10 *other characteristics*:
Only identifies clouds passing through zenith hence results nil differ from human observations

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 adress of person responsible for further information*:

Mr David Hatton
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Great Britain

Telephone: +44 (0)1344 855831
Telefax: +44 (0)1344 855897
E-mail: dbhatton@meto.gov.uk
URL: http://www.meto.gov.uk

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

Identification number: **2.1.15.2.** [115]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Handar 450C Ceilometer measures cloud heights to 12,000 feet (for US airport operation) or to 25,000 feet with 25 foot resolution.
2. *First year of operational use*: 1996
3. *Principle of operation*: The 450C is a LIDAR (Light Detection And Ranging) instrument. It fires a series of short, 140-nanosecond infrared light pulses from a gallium arsenide (GaAs) semiconductor laser vertically into the atmosphere. The pulses are scattered back by cloud ceiling or precipitation and detected by the optical receiver. Transit time required for light pulses to travel from the transmitter to a cloud and back is proportional to the cloud height. A silicon avalanche detector receives returned pulses and translates them into a video signal. A high speed ADC and signal processing software result in accurate vertical density profiles for differentiating clouds from fog, hale, rain and snow

Main technical characteristics

4.1	*application*:	Automatic Met Stations; Aeronautical Met Stations
4.2	*measuring range*:	Up to 12,000 feet (3.6 km) or 25,000 (7.62 km)
4.3	*uncertainty*:	± 25 feet (± 7.62 m), ± 1% of reading
4.4	*time constant*:	30 seconds
4.5	*averaging time*:	1. cloud hit data every 30 seconds, 2. cloud layer data averaged over 30 minutes
4.6	*reliability*:	MTBF: 10 years; Results of Laser Life Test: > 10 years
4.7	*interface and output details*:	RS-232: Outputs cloud hit data or cloud layer data as well as maintenance parameters
4.8	*power requirements*:	120/240 VAC, 50/60 Hz
4.9	*servicing interval*:	window cleaning: as needed; Otherwise annual service check

4.10 *other characteristics*:

1. Autonomous operation with interface of PC or other device as well as in met and aeronautical met stations.
2. Performance improvement in detection of clouds at high altitudes, under raining conditions, vertical visibility and resolution.
3. Solar shutter is available to prevent damage to transmitter when sun is directly overhead experienced at installations near the equator.
4. Ceilometer used in SMOOS (US Navy Shipboard Meteorological and Oceanographic Observing System) for shipboard use. Mil standards of excessive vibration, water exposure and solar radiation were met. (450S model)
5. Maintenance parameters monitored and reported.
6. Eye Safety: complies with ANSI Standard 36.1; Class I maximum emission level and FDA regulation 21 CFR 1040.

Experiences and other information

5. *Experience from comparisons and tests performed*:
AWOS Certification testing being done for use with AAI NEXWAS; Qualified for use with ASOS (NWS); extensively tested for SMOOS program (450S); AWOS Certification with Handar AWOS (450B) testing at the NWS facility in Sterling Virginia; yearly evaluations performed by State of Minnesota Dept. of Transportation AWOS program office;

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

Ms Kathryn Schlichting
Handar, Inc.
1288 Reamwood Avenue
Sunnyvale, CA 94089
USA

Telephone: 408-734-9640

	Telefax:	408-734-0655
	E-mail:	marketing@handar.com
	URL:	http://www.handar.com

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

Identification number: **2.1.15.3.** [167]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Airborne cloud particle imager records high-resolution digital images of cloud ice crystals and water drops.
2. *First year of operational use*: 1997
3. *Principle of operation*: A 20 ns, high-power pulsed laser images particles on a one-million pixel CCD camera. Particles from 5 μm to 2.3 mm are imaged in focus.

Main technical characteristics

4.1	*application*:	Cloud physics
4.2	*measuring range*:	5 μm to 2.3 mm
4.3	*uncertainty*:	2.3 μm
4.4	*time constant*:	40 frames/s up to 2400 particles/s
4.5	*averaging time*:	N/A
4.6	*reliability*:	Good
4.7	*interface and output details*:	comes with data system
4.8	*power requirements*:	2 kW. 110 VAC, 60 Hz (with de-icing)
4.9	*servicing interval*:	N/A

4.10 *other characteristics*:

The CPI casts an image of a particle on a solid-state CCD camera by freezing the motion of the particle using a 25 ns pulsed, high-power laser diode. Upstream lasers precisely define the depth-of-field (DOF) so that at least one particle in the image is almost *always in focus*. This eliminates out-of-focus sizing errors that have plagued the conventional 2D imaging probes. The CCD camera has a maximum rate of 40 frames s^{-1}. The maximum particle rate is about 2400 particles s^{-1}. To support the very high data rate from the CPI sensor head, a custom all-digital data acquisition system capable of processing data in real time has been designed and built. Since cloud particles arrive asynchronously and occupy a small percentage of the pixels, the pulsed imaging laser is only fired when a particle is present and only the regions of the frames that contain images are recorded. In this way, the raw 40 Mbyte s^{-1} data rate is reduced to < ~0.5 Mbyte s^{-1} (depending on particle size distribution) and written on a 9 Gbyte removable hard drive. The CPI can discriminate small (25 μm) crystals from water drops, identify crystal habit and the degree of crystal riming.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Side-by-side comparison with PMS 2D-C probe shows clear superiority of imaging quality.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*: US$ 5,000

7. *Name and adress of person responsible for further information*:

Dr R. Paul Lawson
SPEC, Incorporated
5401 Western Avenue, Suite B
Boulder, Colorado 80026
USA

Telephone: 303/449-1105
Telefax: 303/449-0132
E-mail: plawson@specinc.com
URL: http://www.specinc.com

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

Lawson, R.P., A.V. Korolev, S.G. Cober, T. Huang, J.W. Strapp and G.A. Isaac (1997): "Improved measurements of the drop size distribution of a freezing drizzle event." Accepted for publication in J. Atmos. Sci.

- Lawson, R.P. (1997): "Improved particle measurements in mixed phase clouds and implications on climate modelling. Proceedings: WMO Workshop on Measurement of Cloud Properties for Forecasts of Weather, Air Quality and Climate." 23-27 June, Mexico City.

- Lawson, R.P., A.J. Heymsfield, T.L. Jensen and S.M. Aulenbach (1998): Shapes, sizes and light scattering properties of ice crystals in cirrus and a persistent contrail during SUCCESS. Submitted to: Geophys. Res. Let.

Identification number: **2.1.15.4.** [184]
Country: **Australia**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* CT12K, Vaisala Ceilometer, measures cloud base heights and vertical visibilities
2. *First year of operational use*: 1995
3. *Principle of operation*: Ceilometers emits a laser pulse vertically which is reflected by moisture in the atmosphere. The backscatter profile produced is processed to determine vertical visibility if fog and haze are present or the height of cloud bases directly over the instrument.

Main technical characteristics

4.1	*application*:	Observation of cloud bases
4.2	*measuring range*:	0 to 3,800 m
4.3	*uncertainty*:	Resolution = 15 m
4.4	*time constant*:	12 s measurement interval
4.5	*averaging time*:	N/A (instantaneous)
4.6	*reliability*:	There have been power supply & auxiliary equipment problems.
4.7	*interface and output details*:	Local equipment interface: RS232C Digital output + customised interface
4.8	*power requirements*:	220 V (or 240 V), 45 Hz to 65 Hz
4.9	*servicing interval*:	Monthly check for darns & window conditioner blower
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
The instrument has performed well in tests. Differences found between the cloud report generated by the Sky Condition Algorithm and the human observer are generally attributable to the different method of obtaining measures, i.e. ceilometer only makes observations vertically.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	~ US$ 2,900

7. *Name and adress of person responsible for further information*:

Ms Nicole Farnsworth
Bureau of Meteorology
150 Lonsdale St
Melbourne Vic 3000
Australia

Telephone: 03 9669 4094
Telefax:
E-mail: n.farnsworth@bom.gov.au
URL: http://

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

Identification number: **2.1.15.5.** [207]
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.

Main technical characteristics

4.1 *application*: To estimate cloud amount
4.2 *measuring range*: Surface to 3,000 m
4.3 *uncertainty*:
4.4 *time constant*: 1 min
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 VAC
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*: N/A

7. *Name and adress of person responsible for further information*:

Dave Dockendorff
Atmospheric Environment Service,
Environment Canada
4905 Dufferin St.
Downsview, Ont.
M3H 5T4
Canada

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Telefax: 416-739-4676
E-mail: Dave.Dockendorff@ec.gc.ca
URL: http://

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: **2.1.15.6.** [208]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Vaisala CT12K Laser Ceilometer. Combined with special Atmospheric Environment hardware and software.
2. *First year of operational use*: 1995
3. *Principle of operation*: Lidar measurement of cloud height combined with a time average to estimate cloud amount in up to 4 layers.

Main technical characteristics

4.1 *application*: Cloud height.
4.2 *measuring range*: Surface to 3,000 m
4.3 *uncertainty*:
4.4 *time constant*: 1 min
4.5 *averaging time*: 1 hour
4.6 *reliability*:
4.7 *interface and output details*: Serial ASCII - To automatic weather station which formulates cloud reports and transmits them by phone.
4.8 *power requirements*: 110 VAC
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*: N/A

7. *Name and adress of person responsible for further information*:

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M3H 5T4
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Telefax: 416-739-4676
E-mail: Dave.Dockendorff@ec.gc.ca
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Cloud processing algorithm has been presented at various conferences. Ceilometer is proprietary to Vaisala.

Other entries related to this category:

1.1.02.4
1.1.06.2
1.1.07.6
1.1.07.7
1.2.03.1
2.1.02.15
2.1.02.17
2.1.06.3
2.1.07.2
2.1.07.3
2.1.09.6
2.1.09.7
2.3.00.4

Identification number: **2.2.1.2.** [021]
Country: **Poland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Portable Meteorological System "AGAT-20"
2. *First year of operational use*: 1993
3. *Principle of operation*: Temperature sensor (Pt100), humidity sensor (capacity), pressure sensor (Piezo-resistance), digital sensors of wind speed and direction. SMD technology, microprocessor controlled set of sensors, smart power supply, data display and storage on hand PC.

Main technical characteristics

4.1	*application*:	Field meteorological measurements
4.2	*measuring range*:	T: -40 to +50°C, P: 800 to 1070 hPa, Wind: 0 to 360°, 0 to 50 m/s, U: 0 to 100%RH
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	5 s, 2 min, 10 min
4.6	*reliability*:	MTBF: 3000 h
4.7	*interface and output details*:	RS232 or RS485, data transfer protocol according to customer's requirements
4.8	*power requirements*:	Internal: 12 V/7 Ah battery, external: 10 to 30 VDC
4.9	*servicing interval*:	Annual certification

4.10 *other characteristics*:
Designed for military applications; man-portable, total mass - 15 kg; one person operation; operation readiness - 10 min; module construction (wind transducers, temperature and humidity in radiation shelter, mast, central processing unit with pressure transducer, power supply with batteries, hand PC, transportation case;
Sampling: Wind (1 s), temperature (4 s), pressure (16 s); user defined averaging periods; real-time clock; Hand PC: 386-26 MHz; DOS 6.22; 3 MB RAM, 5 MB Flash; VGA 640x480, scroll window 128x128 pixels; 2x RS232 (one for user), centronics; option: PCMCIA; output in ASCII code; data stored on hand PC's and transferred to other systems via RS232;
Software: data acquisition, display, computing, storage, exchange, sensors calibration at user's place.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Compact, light weight, simple operation, hand PC equipped (PC compatible)

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	no consumable

7. *Name and adress of person responsible for further information*:

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Poland

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E-mail: aviomet@wonet.com.pl
URL: http://

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

Identification number: **2.2.1.3.** [022]
Country: **Poland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Dispersed Meteorological Measurement System "MetNet"
   Basic: Temperature and relative humidity, wind speed and direction, atmospheric pressure.
   Option: Precipitation, solar radiation, visibility, cloud base.
2. *First year of operational use*: 1996
3. *Principle of operation*: Smart measurement units connected by a communication bus and controlled by central PC. Smart measurement unit's processor controls its sensors, verifies data, computes into measurement units, transfer data to central PC on its request. Bus provides communication and power supply for remote measurement units. Central PC supervises data collection, display and creates local measurement data base.

Main technical characteristics

4.1 *application*: Stationary meteorological measurements systems
4.2 *measuring range*: T: -40 to +50°C, P: 800 to 1070 hPa, wind: 0 to 360°, 0 to 50 m/s, U: 0 to 100%RH
4.3 *uncertainty*:
4.4 *time constant*:
4.5 *averaging time*: 5 s, 2 min, 10 min
4.6 *reliability*:
4.7 *interface and output details*: Any available on PC
4.8 *power requirements*: 220 or 110 VAC
4.9 *servicing interval*: Annual certification
4.10 *other characteristics*:
System includes: Smart measurement units, PC, bus, measurement unit power supply; Measurement units (wind, temperature and humidity, pressure, precipitation) and 4-wire bus application allows unconstrained measurement points dislocation in vat areas; Module construction and configurable software enable easy (by user himself) upgrading of the system from a single measurement unit system through multi-point airport systems;
Sensors sampling: 1 s; user defined data collection frequency; averaging periods: 2 and 10 min;
Central PC: Pentium® 100MHz; Windows™95 or Windows™NT; 16 MB RAM; HDD 850 MB; SVGA color; 2x RS232, Centronics; option: Modem;
Software: Data acquisition, data and base display, computing, storage, sensors calibration at user's place;
System includes passive displays for additional data display. Other producers' instruments plugged into system via bridges possibility.

Experiences and other information

5. *Experience from comparisons and tests performed*:
   Module construction, easy upgrading, typical PC, user friendly software.

6. Costs:

6.1 *unit cost at factory*:
6.2 *annual operating costs*: No consumable

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.2.1.4.** [033]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Z-Link IIa: AWOS/ASOS telemetry, data aggregation and communication system.
2. *First year of operational use*: 1996
3. *Principle of operation*: a) Bi-directional VSAT satellite communication
   b) Intel based processor, Windows 95 OS, C^{++} application software
   c) Certified FAA NADIN/WMSCR communication gateway
   d) Proprietary VSAT earth station hardware and software

Main technical characteristics

4.1	*application*:	AWOS/ASOS data collection, aggregation and communication
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*:	99.8% observation throughput
4.7	*interface and output details*:	Satellite KU-band communication frequency 14.5 GHz, RS232 AWOS/ASOS communication interface and U.S. METAR/SPECI observation compliant processing
4.8	*power requirements*:	110 VAC, 60 Hz
4.9	*servicing interval*:	36 months

4.10 *other characteristics*:
Z-link is a bi-directional, satellite based, communication system, which provides data collection telemetry to remote data sources and transfers time critical AWOS/ASOS data sets (METAR), at frequent (60 s) intervals through a central data aggregation facility to the NWS for global distribution. Z-link is both a multi-point (remote sensor array) to point (HUB) and a point to multi-point communication system. Z-link delivers more reliable, maintainable, expandable and cost-effective communications than equivalent terrestrial communication or other satellite communications solutions

Experiences and other information

5. *Experience from comparisons and tests performed*:
The Z-link telemetry package consistently delivers 99% observation throughput performance at 140+ aviation AWOS/ASOS locations across USA. By comparison, other communication alternatives deliver 94% to 96% observation throughput reliability

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 1,800 (US$ 150 per month)

7. *Name and adress of person responsible for further information*:

Mr William E. Beck,
PAN AM Systems, Inc.,
6300 34th Avenue South
Minneapolis, Minnesota 55450
USA

Telephone: (612) 727-1084
Telefax: (612) 727-3895
E-mail: panam@panamsys.com
URL: http://

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

Identification number: **2.2.1.5.** [044]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* YESDAS-2, Environmental Data Logger - field data logger acquires and measures up to 32 analog voltages/currents and up to 6 digital pulse counter/accumulator inputs. Runs from 12 VDC or AC line voltages. Environmentally sealed enclosure, AC power supply can also power other sensors, such as a Multifilter Rotating Shadowband Radiometer.
2. *First year of operational use*: 1992
3. *Principle of operation*: Microprocessor-controlled autonomous system monitors a 32-input self-calibrating A/D converter, with 16-bit digital accumulators. Data are stored in memory and retrieved via terminal emulator supporting Xmodem to the host computer. Analysis software to apply engineering units and plot data is available on PC/Mac/UNIX platforms.

Main technical characteristics

4.1 *application*: Remote environmental data collection
4.2 *measuring range*: 32 single ended channels of ±0 to 4 Volts, with 4 of these channels supporting either differential voltage or current inputs.
4.3 *uncertainty*: < bit (one part in 8192, or approximately 0.01%) over +/- 50°C
4.4 *time constant*: N/A
4.5 *averaging time*: Programmable over intervals from 1 second to 12 hours
4.6 *reliability*: Designed for long-term unattended field use
4.7 *interface and output details*: Sensors: Screw terminals, enclosure also provides space for auxiliary equipment such as telephone modems. Direct connected host computer or modem: RS-232 (DTE), also has removable PCMCIA memory card option that permits the user to hot-swap the card and retrieve data without restarting the system.
4.8 *power requirements*: 12 V battery or 110/220/240 VAC 50-60 Hz line, current draw depends on sensors configured, typical is 0.5 A
4.9 *servicing interval*: Annual calibration
4.10 *other characteristics*:
The system is enclosed in a NEMA-4 box that permits all weather operation over the extended temperature range of ±50°C

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*: Communication charges, depends on phone charges

7. *Name and adress of person responsible for further information*:

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Yankee Environmental Systems, Inc.
101 Industrial Boulevard
Turners Falls MA 01376
USA

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Telefax: (+1) 413 863-0255
E-mail: info@yesinc.com
URL: http://www.yesinc.com/

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

Identification number: **2.2.1.6.** [047]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Indication of meteorological parameters required for helicopter approach on board of offshore platform.
2. *First year of operational use*: 1997
3. *Principle of operation*: A build-in barometric pressure sensor foresees in the information to calculate QFE, QNH and trend. Further the indicator displays all necessary wind information, two other displays can show air temperature and sea water temperature.

Main technical characteristics

4.1 *application*: Offshore platforms
4.2 *measuring range*: 800 to 1100 hPa, -40 to +60°C, 0 to 99 m/s, 0 to 360°
4.3 *uncertainty*: N/A
4.4 *time constant*: N/A
4.5 *averaging time*: 2, 10 min. or user selectable
4.6 *reliability*: good
4.7 *interface and output details*: N/A
4.8 *power requirements*: 220 VAC, 115 VAC or 24 VDC
4.9 *servicing interval*: 3 years
4.10 *other characteristics*:
Catalog number OMC-934. 8 analogue sensor inputs 16 bit analogue to digital conversion. Four 5 digit display. Display can be setup to customer specification e.i displays can show several different parameters like Temperature, Humidity, Solar radiation, Barometric pressure, Precipitation and many others.

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 adress of person responsible for further information*:

Mr Tjeerd Borst
Observator Instruments
Rietdekkerstraat 6
P.O. Box 60
2980 AB Ridderkerk
The Netherlands

Telephone: 00-31-(0)180-463422
Telefax: 00-31-(0)180-463510
E-mail: observator@pi.net
URL: http://

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

Identification number: **2.2.1.7.** [048]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Groweather system, an automated station monitoring conditions to estimate evapotranspiration
2. *First year of operational use*: 1996
3. *Principle of operation*: Groweather uses microprocessor technology in an automated weather station to read sensors and measure conditions in order to calculate evapotranspiration estimate, using a form of the Penman-Monteith equation

Main technical characteristics

4.1	*application*:	Irrigation, Agriculture
4.2	*measuring range*:	
4.3	*uncertainty*:	±5% of actual ET_0
4.4	*time constant*:	
4.5	*averaging time*:	ET_0 calculated hourly
4.6	*reliability*:	
4.7	*interface and output details*:	LCD display on included console interface. Also RS232C compliant
4.8	*power requirements*:	12 VDC, converted 110 VAC or 220 VAC
4.9	*servicing interval*:	Annual visible inspection; 2 year sensor calibration.
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Accuracy and resolution are according to specifications. No recalibration has yet been necessary

6. Costs:

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

7. *Name and adress of person responsible for further information*:

Mr Russ Heilig
Davis Instruments Corp.
3465 Diablo Ave.
Hayward, CA 94545
USA

Telephone:	510-732-9229
Telefax:	510-732-9188
E-mail:	rheilig@davisnet.com
URL:	http://www.davisnet.com

8. *Major bibliographic references, applicable patents, etc.:*
- Jensen, M.E., R.D. Burman and R.G. Allen, editors (1990): "Evapotranspiration and irrigation water requirements", American Society of Engineers, ISBN 0-97282-763-2

Identification number: **2.2.1.8.** [049]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Health enviromonitor, an automated station monitoring health related conditions, such as heat stress and UV radiation
2. *First year of operational use*: 1996
3. *Principle of operation*: Health enviromonitor uses microprocessor technology in an automated weather station to measure conditions of health impact, including UV radiation, solar radiation, humidity and wind chill

Main technical characteristics

4.1	*application*:	Recreation, institutions
4.2	*measuring range*:	
4.3	*uncertainty*:	±8% of actual UV dosage
4.4	*time constant*:	
4.5	*averaging time*:	Varies as to the sensor in question
4.6	*reliability*:	
4.7	*interface and output details*:	LCD display on included console interface; also RS232C compliant
4.8	*power requirements*:	12 VDC, or converted 110 VAC or 220 VAC
4.9	*servicing interval*:	annual visible inspection; 2 year sensor calibration
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Accuracy and resolution are according to specifications. No recalibration has yet been necessary

6. Costs:

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

7. *Name and adress of person responsible for further information*:

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8. *Major bibliographic references, applicable patents, etc.:*
None

Identification number: **2.2.1.9.** [050]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Energy enviromonitor, an automated station monitoring energy management related conditions, such as heating and cooling degree days
2. *First year of operational use*: 1996
3. *Principle of operation*: Energy enviromonitor uses microprocessor technology in an automated weather station to measure conditions of an energy related impact, including solar radiation, wind, sun and degree-days

Main technical characteristics

4.1 *application*: Energy, fuel management
4.2 *measuring range*:
4.3 *uncertainty*: Varies as to the sensor in question
4.4 *time constant*:
4.5 *averaging time*: Varies as to the sensor in question
4.6 *reliability*:
4.7 *interface and output details*: LCD display on included console interface. Also RS232C compliant.
4.8 *power requirements*: 12 VDC, or converted 110 VAC or 220 VAC
4.9 *servicing interval*: Annual visible inspection, 2 year sensor calibration
4.10 *other characteristics*:

Experiences and other information

5. *Experience from comparisons and tests performed*:
Accuracy and resolution are according to specifications. No recalibration has yet been necessary

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 100

7. *Name and adress of person responsible for further information*:

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USA

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Telefax: 510-732-9188
E-mail: rheilig@davisnet.com
URL: http://www.davisnet.com

8. *Major bibliographic references, applicable patents, etc.:*
None

Identification number: **2.2.1.10.** [065]
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. *First year of operational use*: 1993
3. *Principle of operation*: Choice of meteorological parameters regularly logged, stored and available for remote interrogation

Main technical characteristics

4.1 *application*: Automatic sampling & storage of meteorological information
4.2 *measuring range*: Standard meteorological ranges
4.3 *uncertainty*: Meets WMO climatological requirements
4.4 *time constant*: Various
4.5 *averaging time*: Various
4.6 *reliability*: Very good
4.7 *interface and output details*: Modem and telephone link
4.8 *power requirements*:
4.9 *servicing interval*:
4.10 *other characteristics*:
A selection of the following parameters can be logged:
- Wind speed, wind direction, max. gust
- Air temperature, soil temperatures, grass & concrete temperatures, wet bulb temperature
- Relative humidity
- Radiation & sunshine
- Precipitation (tipping bucket raingauge)

A local display is available

Experiences and other information

5. *Experience from comparisons and tests performed*:
Good reliability and performance

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

7. *Name and adress of person responsible for further information*:

Mr David Hatton
The Met. Office, MET O(OLA)1a
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URL: http://www.meto.gov.uk

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

Identification number: **2.2.1.11.** [103]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wave processing module (wpm) hardware and including software, which acquires output from sensors aboard a buoy and reduces them to directional wave data
2. *First year of operational use*: 1994
3. *Principle of operation*: Applies thee Lonquet-Higgins methods for estimating directional wave spectra parameters from pith-roll buoy motions

Main technical characteristics

4.1	*application*:	Provides estimates of ocean wave data directional and non-directional
4.2	*measuring range*:	0 ≤ significant wave height (m) ≤ 20, 0 < mean wave
4.3	*uncertainty*:	degrees of freedom = 24
4.4	*time constant*:	
4.5	*averaging time*:	40 min (maximum)
4.6	*reliability*:	Good
4.7	*interface and output details*:	Connects to a payload, which powers and controls it
4.8	*power requirements*:	On average: 6.0 Ah/day @ 12 V
4.9	*servicing interval*:	Typically 6 months to a year
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Comparisons to other instruments successful

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 10,000 (estimated, aboard buoy)

7. *Name and adress of person responsible for further information*:

Mr Kenneth E. Steele
National Data Buoy Centre
Building 1100
Stennis Space Centre, MS 39529
USA

Telephone: (601) 688-2807
Telefax: (601) 688-3153
E-mail: ksteele@ndbc.noaa.gov
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Vaisala technical manual for humidity sensors

Identification number: **2.2.1.12.** [114]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Handar automatic met stations include suite of sensors and 555 data collection platform for sensor identification, data processing, data storage and transmission of data. Typical stations include: wind speed and direction, relative humidity and air temperature and barometric pressure. Other sensors can be used including visibility sensor and ceilometer.
2. *First year of operational use*: 1991 (DCP); 1996 (RHAT); 1996 (Wind Sensor)
3. *Principle of operation*: The Handar automatic met stations are designed for remote data collection applications. They consist of a suite of sensors and model 555 data collection platform. The 555 controls the sensors, collection and RAM processing of the data and transmission of the data with the use of programming. The software governs the complete aspect of the 555 automated operation. Up to 128K bytes of data may be stored on the on-board with expanded memory capabilities (PCMCIA) available as an option. Data can be retrieved via laptop or PCMCIA card; transmitted via satellite (GOES, METEOSAT, GMS, ARGOS, SCD), interrogated line-of-sight radio, high speed modem, or voice radio or voice modem.

Main technical characteristics

4.1	*application*:	Automatic Met Applications: Fire Weather, Forestry, Military, General Met, Transportation, hydromet applications
4.2	*measuring range*:	Analog inputs: -2.5 to +5 volts; -25 to 50 mV; frequency: 0-3000 Hz; 16 bit counter
4.3	*uncertainty*:	Analog inputs: 0.025%
4.4	*time constant*:	varies depending on sensor and process definitions
4.5	*averaging time*:	varies depending on sensor and process definitions
4.6	*reliability*:	Calculated MTBF (MIL-HDBK-217E): > 12 years
4.7	*interface and output details*:	Inputs: 16 single ended analog; frequency; programmable counter; SDI-12; 8 digital inputs. Outputs: satellite transmitter; RS-232 (Option); line-of- sight radio; PCMCIA modem; voice radio and modem; 8 digital outputs
4.8	*power requirements*:	12 VDC rechargeable
4.9	*servicing interval*:	Dependent on sensors connected to station

4.10 *other characteristics*:

1. Menu driven software for user friendly programming. Over 300 sensor definitions and processes available.
2. Sample rate is reading/second to 1 reading/45 days.
3. Various models available to accommodate customer needs.
4. Extensive lightning protection available.
5. Interfaces to Handar UBS 2000 Universal Base Station via Interrogated Radio, GOES telemetry or modem. Offers customer total network solution for met applications.
6. Interfaces via GOES DRGS Direct Readout Ground Station to UBS 2000 offering customer total network solution for met applications.
7. Different towers are available for mounting the met station be it portable 3 meter tower to permanently installed 10 meter tower.
8. Automatic met station designed to withstand harsh environmental conditions.

Experiences and other information

5. *Experience from comparisons and tests performed*:
Qualification testing done by Bureau of Land Management; Qualification testing done by INPE, Brazil Space Agency; Qualification testing done by State of California Department of Water Resources

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

Ms Kathryn Schlichting
Handar, Inc.
1288 Reamwood Avenue

Sunnyvale, CA 94089
USA

Telephone: 408-734-9640
Telefax: 408-734-0655
E-mail: marketing@handar.com
URL: http://www.handar.com

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

Identification number: **2.2.1.13.** [143]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* QLI50 Data Collector is a compact and flexible sensor interface for measuring large variety of analog and digital sensors. It is designed for operating under harsh environmental conditions. It has 20 analog, 8 digital and two frequency input channels which are fully user configurable. It also provides sensor excitations. QLI50 converts the sensor information to engineering units and provides an ASCII output to a host device via serial RS-232 or RS-485 channel. The host device can be a computer or Vaisala's QLC50 or MILOS 500 system.

2. *First year of operational use*: 1994

3. *Principle of operation*:
- flexible interfacing of analog and digital sensors.
- designed for demanding application under harsh environment, protected against ESD and EMI, extended operating temperature range.

Main technical characteristics

4.1	*application*:	As a remote sensor interface for a host device, reducing the length of the sensor cables and thus increasing the reliability of a measuring system
4.2	*measuring range*:	Measures all analog and digital sensors with full accuracy over the whole operating temperature range of -50 to +85 °C, 16 bits A/D accuracy
4.3	*uncertainty*:	N/A
4.4	*time constant*:	N/A
4.5	*averaging time*:	N/A
4.6	*reliability*:	better than 15,000 hours
4.7	*interface and output details*:	RS-232 or RS-485 output
4.8	*power requirements*:	11 to 50 VDC, less than 1 W
4.9	*servicing interval*:	no regular maintenance required
4.10	*other characteristics*:	

- 16 bits A/D converter
- small and robust sensor interface

Experiences and other information

5. *Experience from comparisons and tests performed*:
- environmental test made against several MIL-standards
- already over 1,500 system in operational use in over 30 countries

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Only power cost

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.2.1.14.** [144]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* QLC50 Data Collector is a compact and flexible system for measuring large variety of analog and digital sensors. It is designed for operating under harsh conditions. It has 20 analog, 8 digital and two frequency input channels which are fully user configurable. It also provides sensor excitations. QLC50 has two serial I/O ports for interfacing with intelligent sensors and communication devices. It supports message coding in the standard WMO's formats such as SYNOP, METAR and SPECI.

2. *First year of operational use*: 1995

3. *Principle of operation*:
- Fully user configurable system using open architecture software under true multi-tasking operating system.
- supports coding of WMO messages such as SYNOP, METAR and SPECI even at remote sites.
- flexible interfacing of analog, and digital sensors.
- modular hardware for building up systems with few sensors up to tens of sensors and outputs.
- designed for demanding application under harsh environment, protected against ESD and EMI, extended operating temperature range.

Main technical characteristics

4.1	*application*:	Semi Automatic synoptic stations, climatological observations, automatic observation onboard the ships and oil platforms, research weather stations, small airport met. systems
4.2	*measuring range*:	Measures all analog and digital sensors with full accuracy over the whole operating temperature range of -50 to +85°C
4.3	*uncertainty*:	N/A
4.4	*time constant*:	Includes an accurate, temperature compensated Real Time Clock for time stamping of observations as well as for timed events.
4.5	*averaging time*:	each sensor input and/or calculation can be configured independently
4.6	*reliability*:	better than 15,000 hours
4.7	*interface and output details*:	Output reports and messages are user configurable, the standard messages include SYNOP, METAR, SPECI and a message for spreadsheet programs.
4.8	*power requirements*:	11 to 50 VDC, approx. 1.5 W
4.9	*servicing interval*:	no regular maintenance required

4.10 *other characteristics*:
- 16 bits A/D converter
- Configuration Software in the MS-Windows environment; including modules for calculations, reports, commands and a special Wind Handler for calculating wind data either in vector or/and scalar formats
- data storage capacity up to 20 MBytes using Flash PC cards
- possibility to connect several QLI50 Sensor Collectors (interfaces) for extending the measuring system
- small and compact system

Experiences and other information

5. *Experience from comparisons and tests performed*:
- environmental test made against several MIL-standards
- already over 1,200 system in operation use in over 30 countries

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Only power and communication cost

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.2.1.15.** [145]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* MILOS 500 Automatic Weather Station for measuring large variety of analog and digital sensors, as well as sensors with serial outputs such as Present weather, cloud base and cover, hydrological parameters and air quality. Up to 10 pcs serial ports for interfacing with communication devices, operator's terminal and graphical and numerical displays.
2. *First year of operational use*: 1992
3. *Principle of operation*: - Fully user configurable system using open software architecture under true multi-tasking operating system.
   - supports coding of WMO messages such as SYNOP, METAR and SPECI even at remote sites.
   - flexible interfacing of analog, digital and serial sensors.
   - modular hardware for building up systems with few sensors up systems with tens of sensors and outputs.
   - designed for demanding application under harsh environment, protected against ESD and EMI

Main technical characteristics

4.1	*application*:	Fully and Semi-Automatic synoptic stations, climatological observations, automatic observation onboard the ships and oil platforms, research weather stations, small airport meteorological systems
4.2	*measuring range*:	Measures all analog and digital sensors with full accuracy over the whole operating temperature range of -50 to +60°C
4.3	*uncertainty*:	N/A
4.4	*time constant*:	Includes an accurate, temperature compensated Real Time Clock for time stamping of observations as well as for timed events.
4.5	*averaging time*:	each sensor input and/or calculation can be configured independently
4.6	*reliability*:	better than 10,000 hours
4.7	*interface and output details*:	Output reports and messages are user configurable, the standard messages include SYNOP, METAR, SPECI and a message for spreadsheet programs.
4.8	*power requirements*:	11.5 to 80 VDC, 12 to 50 VAC, approx. 1.5 W
4.9	*servicing interval*:	no regular maintenance required

4.10 *other characteristics*:
- interfacing up to 100 sensors with options
- Configuration Software in the MS-Windows environment; including modules for calculations, reports, commands and a special Wind Handler for calculating wind data either in vector or/and scalar formats
- data storage capacity up to 40 MBytes using Flash PC cards
- up to 10 configurable serial ports for sensors and communication devices
- options included also a silicon based pressure sensor module and a voice syntetisizer

Experiences and other information

5. *Experience from comparisons and tests performed*:
   - environmental test made against several MIL-standards
   - already over 1,000 system in operation use in over 50 countries

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	only power and communication cost

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.2.1.16.** [160]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* AUTOSONDE, Full Automation of Upper Air Radiosonde Observations. Totally 24 unmanned, unattended radiosonde pre-flight preparations, balloon filling, radiosonde release and data reception is performed. Automatic radiosonde data reception, decoding, message generation and transmission.
2. *First year of operational use*: 1995
3. *Principle of operation*: Measurements are based on the use of balloon-borne radiosonde which transmits data to the ground station during its ascent at a frequency of 403 MHz or 1680 MHz. Pressure, temperature and humidity (PTU) are measured by sensors in the radiosonde. The movements of the radiosonde are determined by means of Navigation Aids networks (NAVAID). The radiosonde includes a receiver module for this purpose. NAVAID signals are relayed to the ground station for processing and for wind vector computation.
   Wind finding methods:
   - GPS (Global Positioning System) 403 MHz telemetry.
   - Loran-C 403 MHz telemetry.
   All radiosonde pre-flight preparations, including balloon filling, radiosonde release and data reception are performed automatically. Data reception, decoding, message generation and transmission are automatic. Radiosonde launch times can be preprogrammed or a launch can be requested with a remote control system.

Main technical characteristics

4.1	*application*:	Full Automation of Upper Air Radiosonde Observations at synoptic stations
4.2	*measuring range*:	24 unmanned, unattended observations
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	
4.6	*reliability*:	>97,5% data availability (performed observations with transmitted data set)
4.7	*interface and output details*:	Either Public dial up modem lines or LAN or dedicated lines with RS232C.
4.8	*power requirements*:	230 V, 50 HZ, 16 A, 1-phase or 400/230 V 50 Hz, 10 A, 3-phase
4.9	*servicing interval*:	Radiosonde and balloon loading every 24 observations, technical service interval is 3 months

4.10 *other characteristics*:

- can be used with GPS, Navy VLF, and Loran-C windfinding
- supports all Vaisala radiosonde types, including radioactivity soundings. Ozone soundings can not be performed automatically.

Experiences and other information

5. *Experience from comparisons and tests performed*:

Test of an Automatic Balloon Filling and Launching System in an Operational Environment, Reported by Ture Hovberg, CIMO Report No. 57, 1994

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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

Identification number: **2.2.1.17.** [191]
Country: **Japan**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Surface Meteorological Observation equipment (JMA - 95 type): Measurement of temperature, pressure, humidity, surface wind, precipitation, radiation, sunshine duration, visibility and present weather.
2. *First year of operational use*: 1996
3. *Principle of operation*: The equipment bas the following 3 functions: a) to acquire 5 kinds of meteorological data and to check their data quality automatically, b) to watch all-sensor's condition, c) to make and send SYNOP reports

Main technical characteristics

4.1 *application*: Surface meteorological observations at manned or automatic surface station
4.2 *measuring range*: Temperature: -50 to 50°C, pressure: 600 to 1100 hPa, Humidity: O to 100%RH, Surface wind: 0.5 to 90 m/s, Precipitation: 0.5 mm per pulse, Radiation: O to 1.5 kW/m^2, Sunshine duration: ON (≥0.12 kW/m^2) or OFF, Visibility: 10 m to 50 km
4.3 *uncertainty*:
4.4 *time constant*:
4.5 *averaging time*:
4.6 *reliability*:
4.7 *interface and output details*: RS232C
4.8 *power requirements*: 100 VAC, 10 A
4.9 *servicing interval*: Manned surface station: daily to half-yearly as condition; Automatic surface station: Monthly to half-yearly as condition
4.10 *other characteristics*:
PC (NEC PC-9821 series) and MS-Windows NT are used for the data processing.

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 adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.2.1.18.** [198]
Country: **Mexico**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Automatic Meteorological Station (Ericson). Model EMA-7. Temperature, precipitation, humidity, pressure, radiation, soil temperature, grass temperature, wind direction & speed - sensors.
2. *First year of operational use*: 1992, installation ended in 1993
3. *Principle of operation*: Digitalization, archiving, deployment, transmission & distribution of meteorological information. Data transmission via satellite and other equipment.

Main technical characteristics

4.1	*application*:	Meteorological, climatological & prediction
4.2	*measuring range*:	Temperature: -30 to +70°C, RH: 10 to 100%, Pressure: 600 to 1100 hPa, precipitation: Infinite, radiation: 305 to 2800 nm, soil temperature: -30 to 70°C, wind direction: 1 to 360°, wind speed: 1 to 65 m/s
4.3	*uncertainty*:	Temperature: 0.3°C, RH: 2%, pressure: 0.1%, precipitation: 3%, radiation: 0.5%, soil temperature: 0.3°C, wind direction: 1.41°, wind speed: 2%
4.4	*time constant*:	10 min; for precipitation: Instantaneous
4.5	*averaging time*:	
4.6	*reliability*:	
4.7	*interface and output details*:	Sensor signals to one interface, then to a main module that sends them to the satellite. Output to a computer, a modem or a printer, can also be received on a main modem.
4.8	*power requirements*:	Supply 127 V, transformer 24 V, The sensors will need 5 to 12 V.
4.9	*servicing interval*:	Every 6 months
4.10	*other characteristics*:	Local archiving: Computer, floppy disk. Communication: Via satellite and/or mobile system. Maintenance experience: Power supply, serial card, multiplexing card, satellite transmitter. Processing: On the computer: Synoptic reports, time data, daily and every 10 minutes. On the main module: Sensor data every 2 minutes, dew point data, pressure, trend, accumulated rain and various maximum data. Protection against environmental deterioration: Erosion & humidity. 65 stations are already installed, 45 operational

Experiences and other information

5. *Experience from comparisons and tests performed*: Difference in mean temperature: 1°C, pressure: 1.5 hPa, humidity: 8%. main failures: Humidity & salt accumulated on connection device; sensitive to electrical discharge & voltage variations

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 2,770 (per station)

7. *Name and adress of person responsible for further information*:

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11860 Mexico, D.F.
Mexico

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URL: http://

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

Identification number: **2.2.1.19.** [204]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* AWOS (Automatic Weather Observing System) also known as READAC (Remote Environmental Automatic Data Acquisition Concept) automatic weather station.
2. *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.

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 VAC
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*: dependent on sensor complements.

7. *Name and adress of person responsible for further information*:

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Environment Canada
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Downsview, Ont.
M3H 5T4
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URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
- "Readac" has been trademarked to the Atmospheric 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

Other entries related to this category:

1.1.02.9	1.1.06.2	1.2.05.1	2.1.06.8	2.1.09.8
1.1.03.1	1.1.07.4	2.1.02.1	2.1.07.2	2.1.15.2
1.1.04.2	1.1.07.5	2.1.02.5	2.1.07.3	2.1.15.4
1.1.04.3	1.1.07.6	2.1.02.15	2.1.07.4	2.2.02.3
1.1.05.4	1.1.07.7	2.1.02.16	2.1.07.5	
1.1.05.5	1.1.07.8	2.1.02.22	2.1.07.6	
1.1.05.6	1.1.08.1	2.1.02.31	2.1.08.1	
1.1.05.7	1.1.10.1	2.1.05.8	2.1.09.4	

Identification number: **2.2.2.1.** [038]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* YESPRT Standard Meteorological Thermometer - Portable aspirated, shielded temperature sensor for use as monitoring system or transfer calibration standard, Measures air temperature and reports value on RS-232 serial port. Supplied software logs data based on Lab View Software for PC or Macintosh.
2. *First year of operational use*: 1996
3. *Principle of operation*: Ambient air is drawn over triple shielded platinum resistance thermometer. Housing will accommodate Standard Platinum Resistance Thermometer (SPRT) or YES-supplied platinum probe. Microprocessor-control system monitors sensor, performs daily auto-calibration cycle, and interfaces with Lab View software running on PC/Mac Windows 3.X, 95 or Mac-OS 7&8.

Main technical characteristics

4.1 *application*: Remote environmental dew point, temperature and pressure collection
4.2 *measuring range*: ±50°C
4.3 *uncertainty*: 0.01°C over ±50°C temperature range
4.4 *time constant*: 1 min
4.5 *averaging time*: Programmable
4.6 *reliability*: Designed for long-term unattended field use
4.7 *interface and output details*: RS-232 (DTE) output can also feed external data logger or Data Management System. System requires customer-supplied PC/Mac running Windows or Mac OS.
4.8 *power requirements*: 110/220/240 VAC 50-60 Hz line 0.5 A typical.
4.9 *servicing interval*: Annual calibration
4.10 *other characteristics*:
The system is enclosed in a NEMA-4 box and mounts to a tower or other support structure. Designed for operational temperature range of ±50°C

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*: US$ 995 (annual calibration)

7. *Name and adress of person responsible for further information*:
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Telefax: (+1) 413 863-0255
E-mail: info@yesinc.com
URL: http://www.yesinc.com/

8. *Major bibliographic references, applicable patents, etc.:*
N/A (pending)

Identification number: **2.2.2.2.** [045]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Wind speed and direction display suitable to accept information from 4 different sensors.
2. *First year of operational use*: 1997
3. *Principle of operation*: Display reads the information of all connected sensors and stores the information to make it possible when switching to a different sensor to show immediately the relevant calculated information of the selected sensor. Selected sensor is indicated by 2 digit display showing runway heading.

Main technical characteristics

4.1 *application*: Airfields
4.2 *measuring range*: 0 to 100 m/s , 0 to 360°
4.3 *uncertainty*: N/A
4.4 *time constant*: N/A
4.5 *averaging time*: 2, 10 minutes or user selectable interval
4.6 *reliability*: very good
4.7 *interface and output details*: RS422, RS232 and daisy chain currentloop
4.8 *power requirements*: 220 VAC, 115 VAC or 24 Vdc
4.9 *servicing interval*: none
4.10 *other characteristics*:
Catalog number OMC-137; maximum of 4 wind sensors. Switching over give immediately the correct calculate information of the selected sensor. Display can be used with different type of wind sensor like Obsermet, Vector, Gill, Young and Irdam.
All sensor inputs controlled by watchdog. Double led circle for average and actual wind direction. Warning led's for windspeed above 10 knots, wind direction variation more than 60 degrees, and sensor fail warning led. Windspeed units selectable in m/s, km/h, kt, mph and beaufort. Sensor indicating via runway heading.

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 adress of person responsible for further information*:

Mr Tjeerd Borst
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E-mail: observator@pi.net
URL: http://

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

Identification number: **2.2.2.3.** [132]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* An electro-optical lightning detection, classification and ranging sensor-cloud to cloud, cloud to ground omnidirectional 30 mile.
2. *First year of operational use*: 1996-1997
3. *Principle of operation*: The sensor has pulse shaped logic that operates on the electric field signal to determine "cloud discharge or ground discharge." Peak radiation field change and electro field change are monitored to determine range optical coincidence noted to reject man made noise.

Main technical characteristics

4.1	*application*:	Weather OBS, MET/Aviation
4.2	*measuring range*:	0 to 5, 5 to 10 and 10 to 30 mile.
4.3	*uncertainty*:	
4.4	*time constant*:	
4.5	*averaging time*:	1 min
4.6	*reliability*:	TBD
4.7	*interface and output details*:	RS232, RS422, Fiber optic, serial ASCII
4.8	*power requirements*:	90 to 120 V, 220 V and 24 V
4.9	*servicing interval*:	3 years
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Final test, by Hughes STX for NWS, ASOS Program (USA)

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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2705 East Medina
Tucson, Arizona
USA

Telephone: 520-741-2838
Telefax: 520-741-2848
E-mail: gai@sedona.net
URL: http://www.glatmos.com

8. *Major bibliographic references, applicable patents, etc.:*
- "An Electro-Optical Lightning Detection, Classification and Ranging Sensor for Automatic LTX Protection and Human Safety", First International Conference, Berlin, Germany, September, 1992
- Canniff, John: "Certification requirements for a Thunderstorm Detection System", Dept. of Transportation, TSC.
- Final test report for Single Site Lightning Detection by the Hughes STX Corporation
- Patents: 4,806,851 Thunderstorm sensor & method of identifying & locating thunderstorms; 5,168,212 Autonomous Electro-Optical Lightning Identification & Ranging Apparatus for, and Method of Alerting Humans and Protecting Equipment; 4,198,599 Gated Lightning Detection System; 4,115,732 Detection System for Lightning; 4,276,576 Lightning Activated Relay

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Other entries related to this category:

1.1.05.3	1.1.07.4	2.1.05.8	2.1.09.4	2.2.01.14
1.1.05.4	1.1.07.5	2.1.06.8	2.1.09.9	2.2.01.15
1.1.05.5	1.1.07.7	2.1.07.2	2.1.15.2	
1.1.05.6	2.1.01.3	2.1.07.3	2.2.01.4	
1.1.05.7	2.1.02.31	2.1.07.7	2.2.01.5	

2.2.3. Aircraft observations

Identification number: **2.2.3.1.** [027]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* This instrument is called Particulate Volume Monitor (PV-100A); it measures the cloud properties of liquid water content (LWC), droplet surface area (PSA), and droplet effective radius (Re.)
2. *First year of operational use*: 1994
3. *Principle of operation*: Light scattered by droplets in the forward direction out of a laser beam is weighted with variable transmission filters and measured with two large-area detectors to obtain direct proportionality with droplet radius, r^2 and r^3. The former is PSA, and the is LWC; their ratio is proportional to Re.

Main technical characteristics

4.1	*application*:	In-situ measurements of cloud properties for research, and model and remote-sensing validations.
4.2	*measuring range*:	LWC: 0.001 to 10 g/m^3 ; droplet size range: 2 to 50 µm diam.
4.3	*uncertainty*:	LWC: ±%; PSA: ±5%
4.4	*time constant*:	adjustable from 0.0005 to 5 s
4.5	*averaging time*:	N/A
4.6	*reliability*:	Average life of laser: 5 years.
4.7	*interface and output details*:	Three analogue voltage outputs (LWC, PSA, Re), 0 to 10 V
4.8	*power requirements*:	115 or 220 VAC, 60 W; optional de-icing heater: 220 W, 28 VDC
4.9	*servicing interval*:	As needed
4.10	*other characteristics*:	

The probe of this PVM-100A is relatively light (4.5 lbs.) which makes it possible for its use on light aircraft. Some other features: An internal calibration means in the probe permits checking its operation during flight, and a light-diffusing disk, applied manually, is the transfer standard of standard calibrations done earlier in cloud chambers. The relatively large laser-irradiated atmospheric volume (1.25 cm^3) reduces statistical sampling errors to small values. Measurement rates as fast as 2000 Hz are a unique capability. The probe also responds to ice crystals, but a correction must be applied for crystal shape. The PVM-100A is an adaptation of an earlier instrument, PVM-100, designed for ground-based use.

Experiences and other information

5. *Experience from comparisons and tests performed*:

Independent comparison of LWC measured by the PVM with absolute measures of LWC in the CALSPAN, Buffalo, NY chamber (Mie theory and infra-red transmissometer), and in the ECN, Petten, Netherlands continuous-flow cloud chamber (gravimetric filter measurements) showed agreement within 5%.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	Nil

7. *Name and adress of person responsible for further information*:

Dr Hermann Gerber
Gerber Scientific Inc.
1643 Bentana Way
Reston, VA 20190
USA

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Telefax: 703-742-3374
E-mail: gerber@access.digex.net
URL: http://

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

- Gerber, H, 1991: "Direct measurement of suspended particulate volume concentration and far-infrared extinction coefficient with a laser-diffraction instrument", Appl. Opt. 30(1991)4824-4831

- Gerber, H., B.G. Arends and A.S. Ackerman, 1994: "New micro-physics sensor for aircraft use", Atm. Research 31(1994)235-250
- Gerber, H., 1994: "Optical apparatus and method for sensing particulates", U.S. Patent No. 5,315,115; May 24, 1994.

Other entries related to this category:

1.1.04.2
1.1.07.4
1.1.07.7
2.1.04.1
2.1.12.3
2.1.15.3
2.2.01.5

Identification number: **2.2.4.1.** [046]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* True and relative wind display showing windspeed and direction as well as ships speed and heading. Display unit works with information from log and gyro compass as well as information from a global positionings system.
2. *First year of operational use*: 1997
3. *Principle of operation*: From the information of the wind sensor, the ships speed and the information of the gyro compass the display unit calculates the true wind speed and direction.

Main technical characteristics

4.1 *application*: Sea going vessels
4.2 *measuring range*: 100 m/s, 360°
4.3 *uncertainty*: N/A
4.4 *time constant*: N/A
4.5 *averaging time*: 2, 10 min. or users selectable interval
4.6 *reliability*: good
4.7 *interface and output details*: RS422, RS232, currentloop
4.8 *power requirements*: 220 VAC, 115 VAC or 24 VDC
4.9 *servicing interval*: none
4.10 *other characteristics*:
Catalog number OMC-131. Display can be used with different type of wind sensors like Obsermet, Vector, Gill, Irdam and Young. Double led circle relative wind direction showing actual and average wind direction. Display accept NMEA-183 inputs for ships speed and heading. Display provides NMEA-183 output message format for true and relative windspeed and direction. Wind speed units selectable in m/s, km/h, kt, mph and beaufort

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*: none

7. *Name and adress of person responsible for further information*:

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The Netherlands

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Telefax: 00-31-(0)180-463422
E-mail: observator@pi.net
URL: http://

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

Identification number: **2.2.4.2.** [206]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* 3 meter discus, 6 meter boat shaped (Nomad) and 12 meter discus moored meteorological buoys.
2. *First year of operational use*: 1996
3. *Principle of operation*: Conventional instrumentation measuring wind speed and direction, air temperature, air pressure, wave height, wave period, wave spectra, and water temperature using commercial sensors and a data acquisition and processing payload. Buoys are moored in water depths ranging from 16 to 4000 metres. Data is transmitted hourly via satellite.

Main technical characteristics

4.1	*application*:	Marine
4.2	*measuring range*:	Variable (see table in § 4.10)
4.3	*uncertainty*:	(see table in § 4.10)
4.4	*time constant*:	Instrument dependent.
4.5	*averaging time*:	Instrument dependent.
4.6	*reliability*:	Average return of 90 to 98% of all possible messages; please contact the expert for full details (see § 7).
4.7	*interface and output details*:	Main data link is by the GOES satellites with primary reception by NESDIS at Wallops Island, Virginia. Data processing is done in Vancouver, Canada and SN, SM and SI Marine Synoptic bulletins are distributed on the GTS. Backup data and position is by Service Argos satellite to local user terminals in Halifax and Edmonton where the data is decoded and transmitted on the GTS. Moored buoys report hourly.
4.8	*power requirements*:	Battery/Solar power
4.9	*servicing interval*:	1 to 2 years
4.10	*other characteristics*:	***See table on next page***
	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. Two Severe Weather Studies (SWS1 & SWS2) have been conducted to determine buoy performance in severe conditions. Reports are available.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 20,000 to US$ 40,000 (per buoy per year - salary and operating costs only. Ship time not included)

7. *Name and adress of person responsible for further information*:

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Environment Canada
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V6P 6H9
Canada

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Telefax: 604 664 9195
E-mail: Ron.McLaren@ec.gc.ca
URL: http://

8. *Major bibliographic references, applicable patents, etc.:*
Payload propriety to AXYS Environmental Systems Ltd., 2045 Mill Road, Sidney, B.C. Phone No. (250) 656 0881

Table 1. System Accuracy:

PARAMETER	*RANGE*	*RESOLUTION*	*ACCURACY*	*SENSOR*
Wind speed, vector	0 to 60 m/s	0.1 m/s	±1 m/s or 10% whichever is greater	RM Young 5106
Wind dir.	0 to 355°, Wind-dir= 0 when wind speed =0	<1°	±10°	RM Young 5106
Compass	0 to 359.9°	0.1°	±0.5°	KVH C100
Air temp. (Note 1.)	-50 to +50°C	0.1°C	±0.5°C	YSI 44203
Air pressure (Note 2.)	800 to 1060 hPa	0.1 hPa	±0.5 hPa	AIR SB 2A
Sea temp.	-7.0 to +40°C	0.1°C	±0.5°C	YSI 44203
Significant wave height (Note 3.)	± 15 m	0.1 m	±.2 m or 5% whichever is greater	Columbia SA 107B or Datawell
Maximum wave height	± 15 m	0.1 m	as above	
Wave Period (Note 4.)	3.0 to 30.0 s	0.5 s @ 7.9 s	±1 s @ 7.9 s	
House Keeping				
Primary battery bus voltage	7.5 to 24 V	0.1 V	± 5%	
Solar panel current	0.0 to 9.99 A	.01 A	± 5%	
Obstruction lamp current	0.0 to 2.0 A	.01 amps	± 5%	
GOES transmitter cell voltage no load	10.5 to 15.0 V	0.1 volts	± 5%	Synergetics 3426A
GOES transmitter min cell voltage from last transmission	10.5 to 15.0 V	0.1 V	± 5%	Synergetics 3426A
Compass heading	0 - 360°	10 deg	n/a	KVH C 100
Forward RF Power	0-48 dBm	1 dBm	n/a	Synergetics 3426A
Reflected RF Power	0-48 dBm	1 dBm	n/a	Synergetics 3426A
Scalar wind speed	0-60 m/s	0.1 m/s	As for vector speed	RM Young 5106
GPS Position	See data format section		n/a	Trimble 28530-62 (1200 baud)
Water depth (up to 4 per buoy)	See data format section		n/a	See Tbl 4 Junction box pin out

[1] Linear range with this sensor -30°C to +50°C
[2] Accuracy over temperature range of -25°C to +50°C with this sensor.
[3] Accuracy over temperature range of -5°C to +35°C with Datawell heave sensor
[4] Frequency dependent.

Other entries related to this category:

1.1.05.3
1.1.07.4
1.1.07.5
1.1.07.7
2.1.07.2
2.1.07.3
2.2.01.5
2.2.01.11
2.2.02.1

2.2.5. Special profiling techniques for the boundary layer and the troposphere

Identification number: **2.2.5.1.** [030]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* MPT-5, Meteorological Temperature Profiler
2. *First year of operational use*: 1992
3. *Principle of operation*: An angular scanning single channel microwave radiometer with working frequency in molecular oxygen absorbtion band centre at 60 GHz.

Main technical characteristics

4.1 *application*: Meteorology, Environmental Monitoring
4.2 *measuring range*: Altitude 0 to 600 m above surface
4.3 *uncertainty*: Accuracy: 0.2 to 0.5 K
4.4 *time constant*: 120 s
4.5 *averaging time*: 1 s
4.6 *reliability*: 5 years
4.7 *interface and output details*: Digital output for RS232 port of notebook computer
4.8 *power requirements*: 30 W
4.9 *servicing interval*: 1 year
4.10 *other characteristics*:

1. Altitude range 0 to 600 m
2. Sensitivity (at an integration time of 1 s) 0.04 K
3. Height resolution: 50 m
4. Accuracy of temperature profile retrieval: 0.2 to 0.5 K
5. Cycle period of measurement one profile: 120 s
6. Outside temperature range: -50 to +40°C
7. Calibration: Self calibrated.
8. Can operate continuously in all meteorological conditions

Experiences and other information

5. *Experience from comparisons and tests performed*:
Intercomparison with radiosonde, tethered balloon, meteorological tower, sodar, lidar

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

7. *Name and adress of person responsible for further information*:

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E-mail: attex@adonis.iasnet.ru
URL: http://

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

- Troitsky, A.V., K.P. Gaykovich, V.D. Gromov, E.N. Kadygrov and A.S. Kosov (1993), "Thermal sounding of the atmospheric boundary layer in the oxygen absorbtion band centre at 60 GHz", IEEE Trans. on Geosciences and Remote Sensing 31[1](1993)116-120
- Ivanov, A. and E. Kadygrov (1994), Instruments and Observing Methods Report No. 57 (WMO/TD - No. 588), pp. 407-412

Identification number: **2.2.5.2.** [111]
Country: **Russian Federation**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* MTP-5 - Meteorological Temperature Profiler
2. *First year of operational use*: 1992
3. *Principle of operation*: An angular scanning single channel microwave radiometer with working frequency in molecular oxygen absorption band centre at 60 GHz

Main technical characteristics

4.1 *application*: Meteorological Environmental Monitoring
4.2 *measuring range*: altitude 0 to 600 m above surface
4.3 *uncertainty*: Accuracy 0.2 to 0.5 K
4.4 *time constant*: 120 s
4.5 *averaging time*: 1 s
4.6 *reliability*: 5 years
4.7 *interface and output details*: digital output for RS232 Port of notebook computer
4.8 *power requirements*: 30 W
4.9 *servicing interval*: 1 year
4.10 *other characteristics*:
- Altitude range: 0 to 600 m
- Sensitivity (at integration time 1 s): 0.04 K
- Height resolution: 50 m
- Accuracy of temperature profile retrieval: 0.2 to 0,5 K
- Cycle period of measurement profile: 120 s
- Outside temperature range: -50°C to +40°C
- Calibration: Self calibrated
- Can operate continuously in all meteorological conditions

Experiences and other information

5. *Experience from comparisons and tests performed*:
Intercomparison with radiosonde tethered balloon, meteorological tower, sodar, lidar

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

7. *Name and adress of person responsible for further information*:

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URL: http://

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

Identification number: **2.2.5.3.** [135]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Upper air observation system (0 - 30 km) for measurement of atmospheric pressure, temperature, humidity (PTU), wind speed and direction, for fixed and mobile applications.

2. *First year of operational use*: NAVAID 1984, improved NAVAID 1996, RDF 1993. All Commercially available

3. *Principle of operation*: Measurements are based on the use of balloon-borne radiosonde which transmits data to the ground station during its ascent at a frequency of 403 MHz or 1680 MHz. Pressure, temperature and humidity (PTU) are measured by sensors in the radiosonde. The movements of the radiosonde are determined by means of Navigation Aids networks (NAVAID). The radiosonde includes a receiver module for this purpose. NAVAID signals are relayed to the ground station for processing and for wind vector computation.
Wind finding methods:
- GPS (Global Positioning System) 403 MHz telemetry
- Loran-C 403 MHz telemetry
- RDF (Radio Direction Finding) 1680 MHz

Main technical characteristics

4.1	*application*:	Upper air observations, fixed and mobile applications
4.2	*measuring range*:	Pressure 3 to 1060 hPa, temperature -90 to +60 °C, humidity 0 to 100 % RH, wind speed 0 to 180 m/s, wind direction 0 to 360°
		P: 0.5 hPa, T 0.2 °C, U:3 % RH
4.3	*uncertainty*:	not applicable
4.4	*time constant*:	GPS: 1 min., Loran-C 2 min, RDF 2 min
4.5	*averaging time*:	MTBF NAVAID 12000 h, RDF 3000 h
4.6	*reliability*:	RS232, ISDN, LAN, WAN
4.7	*interface and output details*:	100-300 VA, 110 VAC, 220 VAC, 24 VDC
4.8	*power requirements*:	2 years
4.9	*servicing interval*:	
4.10	*other characteristics*:	

- GPS windfinding: suitable for global use, in fixed and mobile field observations
- Loran-C windfinding: limited geographical coverage for fixed and mobile field use
- RDF windfinding: passive independent autonomous system for fixed and mobile field use
- Fully automated observation system for 24 unmanned soundings in GPS and Loran-C mode

Experiences and other information

5. *Experience from comparisons and tests performed*:
PTU, GPS and Loran-C performance documented in official WMO intercomparisons

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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Telefax: +358 9 894 9210
E-mail: hannu.katajamaki@vaisala.com
URL: http://www.vaisala.com

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

Identification number: **2.2.5.4.** [161]
Country: **Finland**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Radiotheodolite RT20. Passive RDF (non-radiating Radio Direction Finding) antenna and receiver operating on 1680 MHz telemetry. Combined with a Vaisala Sounding Processor forms an upper air observation system (0 - 30 km) for measurement of atmospheric pressure, temperature, humidity (PTU), wind speed and direction, for fixed and mobile applications.
2. *First year of operational use*: 1993
3. *Principle of operation*: Measurements are based on the use of balloon-borne radiosonde which transmits data to the ground station during its ascent at a frequency of 1680 MHz. Pressure, temperature and humidity (PTU) are measured by sensors in the radiosonde. The movements of the radiosonde are determined by means of measurement of azimuth and elevation angles to the radiosonde transmitter by the levelled and aligned antenna. The altitude of the radiosonde is determined by a separate Sounding Processor using PTU data (calculation of geopotential height).

Main technical characteristics

4.1	*application*:	Upper air observations, fixed and mobile applications
4.2	*measuring range*:	Pressure: 3 to 1060 hPa, temperature: -90 to +60°C, humidity: 0 to 100%RH, wind speed 0 to 180 m/s, wind direction 0 to 360°
4.3	*uncertainty*:	P: 0.5 hPa, T: 0.2°C, U: 3%RH, Wind: 1 m/s above 17 degrees of elevation, 1.5 m/s above 15 degrees of elevation
4.4	*time constant*:	N/A
4.5	*averaging time*:	2 minutes for wind data
4.6	*reliability*:	MTBF 3000 h
4.7	*interface and output details*:	RS232, ISDN, LAN, WAN
4.8	*power requirements*:	300 VA with a Sounding Processor, 24 VDC or 110/220 VAC
4.9	*servicing interval*:	2 years
4.10	*other characteristics*:	

- Passive independent autonomous system (RDF windfinding) for fixed and mobile field use in all environmental conditions

Experiences and other information

5. *Experience from comparisons and tests performed*:
PTU performance documented in official WMO intercomparisons. Windfinding performance and environmental durability of the Radiotheodolite and Sounding Processor accepted by the leading defence forces.

6. Costs:

6.1 *unit cost at factory*:

6.2 *annual operating costs*:

7. *Name and adress of person responsible for further information*:

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Telefax: +358 9 894 9210
E-mail: keijo.luukkonen@vaisala.com
URL: http://www.vaisala.com

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

Other entries related to this category:

1.1.04.1	2.1.06.3	2.1.13.3
2.1.02.7	2.1.07.3	2.2.01.16

2.2.6. Rocket measurements in the stratosphere and mesosphere

- none -

Other entries related to this category:
[none]

2.2.7. Locating the sources of atmospherics

- none -

Other entries related to this category:
2.1.15.4

Identification number: **2.3.0.1.** [013]
Country: **The Netherlands**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Calibration facility for pyranometers
2. *First year of operational use*: 1995
3. *Principle of operation*: Comparison of field pyranometers to a reference in an indoor experiment (ISO 9847)

Main technical characteristics

4.1 *application*: Quality assurance
4.2 *measuring range*: N/A
4.3 *uncertainty*: ±1%
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*: 220 VAC, 900 VA
4.9 *servicing interval*: N/A
4.10 *other characteristics*:
The procedure is quick and fool-proof, relatively reliable and inexpensive compared to traditional outdoor methods. Facility is described in ISO 9847

Experiences and other information

5. *Experience from comparisons and tests performed*:
Excellent

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

7. *Name and adress of person responsible for further information*:
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the Netherlands

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Telefax: +31 (0)15 262 0351
E-mail: kippmain@pi.net
URL: http://

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

Identification number: **2.3.0.2.** [112]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* The Handar UBS 2000 is the system controller for the automatic met station networks using GOES satellite, modem or line of sight radio telemetry. The pentium based computer uses Windows 95 operating system allowing multiple third party database and application program. Visualization software is used to develop maps of the regional area and show the location of DCP stations.
2. *First year of operational use*: 1997
3. *Principle of operation*: The UBS 2000 has a network controller and interface program developed for each individual telemetry that is being used in the network be it modem, radio or satellite. The programs run independently and simultaneously. The network controller/interface programs run in the background, receiving the data being transmitted from the DCPs. As the data is received by this program it is collected in an Access data base which stores the data until it is used in the various Windows 95 application programs. This methodology supports applications regardless of where they reside. They can be located within the local PC, a LAN or on a system connected via a remote modem connection. Data is simply accessed as a MICROSOFT ACCESS data file. For examples: 1) For visualization and report generation, the data can be used in an EXCELL program or other Windows 95 application software program; or, 2) If you have a system external to the UBS 2000™ which can reference directories and files on the UBS 2000™ computer it can also read data information from our database.

Main technical characteristics

4.1	*application*:	With Automatic Met Stations it offers total network solution for systems transmitting via GOES satellite, radio and modem
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*:	Receives data via DRGS 2000 for GOES telemetry, modem or 555 transceiver for line-of-sight interrogated radio telemetry
4.8	*power requirements*:	120/240 VAC
4.9	*servicing interval*:	1. UBS 2000 Base Station Specifications (minimum): Processor: Pentium 133 Mhz; RAM Memory: 32 MB; Hard Disk Drive: 1.2 GB; CD ROM Drive: 4X; Serial Ports: 2; Mouse: Logitech Track Ball; Monitor: 17”, 16 Bit High Color; Video Card: 16 Bit High Color 1024x768; Modem (optional): 28.8 US Robotics External. 2. UBS 2000 Software Specifications: - Handar UBS 2000 Software - Microsoft Windows 95 - Microsoft Office including WORD, Excel, Access - Encarta 97 World Atlas
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 adress of person responsible for further information*:

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Handar, Inc.
1288 Reamwood Avenue
Sunnyvale, CA 94089

USA

Telephone: 408-734-9640
Telefax: 408-734-0655
E-mail: marketing@handar.com
URL: http://www.handar.com

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

Identification number: **2.3.0.3.** [113]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Handar DRGS 2000 GOES Receiver/Demodulator is an all digital instrument using advanced Digital Signal processing VLSI chips. It is the heart of a GOES Direct Readout Ground Station (DRGS) receiving satellite data from any three user configurable channels simultaneously. The DRGS 2000 is packaged as a desktop unit and can accommodate up to 540 self-timed Data Collection Platforms reporting on a 3 minute interval with one minute transmission slots.
2. *First year of operational use*: 1997
3. *Principle of operation*: The DRGS 2000 is an integrated receiver and demodulator for use in receiving hydromet data via the GOES satellite. The receiver accepts the IF signal from the outdoor downconverter and using advanced MMIC and ASIC technology provides digitally sampled data of the entire frequency spectrum of interest to the all digital demodulator. The demodulator uses Digital Signal Processing (DSP) technology exclusively. Combined with the receiver it is capable of acquiring and demodulating transmissions on any three of the 199 domestic GOES channels or the 33 international channels simultaneously. After the control and processing of the data, the DRGS 2000 communicates the data to the Handar UBS 2000 Universal Base Station which has database and visualization programs to further process and display the data.

Main technical characteristics

4.1	*application*:	With Automatic Stations it offers total network solution for systems transmitting via GOES
4.2	*measuring range*:	IF Frequencies: 70 or 140 MHz
4.3	*uncertainty*:	Frequency uncertainty: ±500 Hz after pilot tone is acquired
4.4	*time constant*:	Channel Acquisition: Time to acquire preamble: < 0.5 s with 90% probability for C/No=25 dB-Hz process short or long preambles specified by NESDIS
4.5	*averaging time*:	N/A
4.6	*reliability*:	Designed for high reliability. For reliability prediction report, consult factory
4.7	*interface and output details*:	RF Input 70 Mhz or 140 Mhz; CPU interface: RS-232 connection to UBS 2000 base station; Diagnostic Port: RS-232
4.8	*power requirements*:	120/240 VAC, 50/60 Hz
4.9	*servicing interval*:	Annual

4.10 *other characteristics*:

1. Outdoor equipment consists of satellite antenna dish, antenna feed, LNA, block downconverter and cabling to the DRGS 2000.
2. DRGS 2000 Size: 17.8 X 22.9 X 6.4 cm
3. Input Signal Dynamic Range: -80 to -20 dBm
4. Signal Quality Measurements: Modulation Index of ± 2° over the range from 40° to 90°; Frequency: 50 Hertz bins over the range of ±500 Hz with a resolution better than 0.01 Hertz; EIRP: 1 dB steps from 32 dBm to 57 dBm with an accuracy of ± 2dB, EIRP referenced to pilot tone which is maintained at 47 dBm nominal.
5. Front Panel Indicators: Power, Fault, Channel A, Channel B, Channel C
6. CPU Interface provides UBS 2000 base station: time stamped received data from all channels, signal quality measurements, spectral power density across entire frequency search range, on-line and off-line status and configuration information, continuous pilot tone signal strength to assist in antenna installation adjustments; receives configuration and control from UBS 2000 base station.
7. An auxiliary RF Outputs of signal present equivalent to the RF input is provided on the back panel which can be used for signal monitoring or connection to WEFAX or GVAR receivers.
8. A special GOES modulated test output for loopback testing at the receiver

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 adress of person responsible for further information*:

Ms Kathryn Schlichting
Handar, Inc.
1288 Reamwood Avenue
Sunnyvale, CA 94089
USA

Telephone: 408-734-9640
Telefax: 408-734-0655
E-mail: marketing@handar.com
URL: http://www.handar.com

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

Identification number: **2.3.0.4.** [163]
Country: **United States of America**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* WSR-88D: S-band, Klystron, Doppler Weather surveillance Radar. Range: Reflectivity - 460 km, Doppler - 230 km. Provides measurement of reflectivity, velocity, spectrum width.

2. *First year of operational use*: WSR-88D: 1991, WSR-98D: 1998. WSA-88D being upgraded with new commercial technology, open systems architecture. WSR-98D is a new system.

3. *Principle of operation*: Pulsed doppler, coherent, linear polarization, electronic clutter suppression, algorithms applied to base data to generate weather products, short + long pulse for precipitation and clear air observations, volume coverage pattern vie single elevation (PPI and RHI)

Main technical characteristics

4.1 *application*: Tropical storm - severe weather detection; rainfall estimates; wind shear.
4.2 *measuring range*: Reflectivity: 460 km, Doppler: 230 km
4.3 *uncertainty*: Reflectivity 1 dB at S/N ≥ 10 dB; velocity better than 1 m/s for S/N > 8 dB
4.4 *time constant*: 3 to 6 RPM
4.5 *averaging time*: 5, 6 or 10 min volume coverage pattern with 4 to 20 elevation cuts
4.6 *reliability*: > 800 hours MTBF
4.7 *interface and output details*: Wideband link Radar to data processor; narrow band for user distribution
4.8 *power requirements*: Four wire, three phase, 120/208 VAC ±10%; minimum: 25 kW
4.9 *servicing interval*: Six months
4.10 *other characteristics*:
- Calibration checks performed at end of each volume coverage pattern
- 95 dB dynamic range
- > 56 dB clutter suppression
- < 1° beam width
- side lobes (with radome): -27 dB
- vast control position for remote control
- extensive bit; operator system status screen
- automated, operator defined warnings
- real-time product distribution to multiple users

Experiences and other information

5. *Experience from comparisons and tests performed*:
Reliability continually improving; system met or exceeded design requirements

6. Costs:
6.1 *unit cost at factory*:
6.2 *annual operating costs*: US$ 108,000 per site (spares, consumables, site maintenance)

7. *Name and adress of person responsible for further information*:
Mr Salvatore LeMole
Lockheed Martin EP5-104 MD 04
Ocean, Radar & Sensor Systems
P.O. Box 4840
Syracuse, NY 13221-4840
USA

Telephone: (315) 456-2220
Telefax: (315) 456-0847
E-mail: sal.lemole@lmco.com
URL: http://www.syr.lmco.com

8. *Major bibliographic references, applicable patents, etc.:*
- Weiss, McGrew and Sirmans (1990): Nexrad (WSR-88D), Microwave Journal (Jan. 1990)
- Klazura and Amy (1993): "Description of initial set of analysis products available from Nexrad WSR-

88D system", Bull. Am. Meteor. Soc. 74[7](July 1993)

Identification number: **2.3.0.5.** [170]
Country: **Singapore**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Locate and discriminate between intracloud and cloud-ground lightning discharges
2. *First year of operational use*: System is in the first year of use
3. *Principle of operation*: The system is based on the long range VHF interferometric localization technique.

Main technical characteristics

4.1	*application*:	Lightning location and discrimination
4.2	*measuring range*:	150 km
4.3	*uncertainty*:	500 m
4.4	*time constant*:	Resolution = 1 μs
4.5	*averaging time*:	100 s
4.6	*reliability*:	Under evaluation
4.7	*interface and output details*:	
4.8	*power requirements*:	400 VA
4.9	*servicing interval*:	Monthly
4.10	*other characteristics*:	

Experiences and other information

5. *Experience from comparisons and tests performed*:
Location of lightning activities compares well with radar returns.

6. Costs:

6.1	*unit cost at factory*:	
6.2	*annual operating costs*:	US$ 66,000

7. *Name and adress of person responsible for further information*:

Mr Tian-Kuay Lim
Meteorological Service Singapore
Changi Airport Post Office
P 0 Box 8
Singapore 918141
Republic of Singapore

Telephone: (65) 5422863
Telefax: (65) 5457192
E-mail: lim_tian_kuay@mss.Gov.Sg
URL: http://

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

Identification number: **2.3.0.6.** [199]
Country: **Canada**

General information

1. *Short identification of the instrument including the parameter measured, or its function:* Remote Video observing system.
2. *First year of operational use*: 1992; operational and under review
3. *Principle of operation*: Commercial Video Technology combined microcomputer processing and display. Data compression and telephone access.

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 dependent 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 adress of person responsible for further information*:

Ben Hunter
Environment Canada
Informatics Division
1496 Bedford Highway
Bedford, Nova Scotia
B4A 1V5
Canada

Telephone: 902-426-9173
Telefax: 902-426-9158
E-mail: ben.hunter@ec.gc.ca
URL: http://

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

Other entries related to this category:

1.1.02.3	2.1.14.1
1.1.14.2	2.2.01.8
2.1.02.18	2.2.01.9
2.1.03.1	2.2.02.3
2.1.06.1	2.2.03.1

Appendix A: Questionnaire

In this Appendix the complete letter concerning the Questionnaire on Instrument Development is presented and complete with annexes, etc.

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41, avenue Giuseppe-Motta
Case postale No. 2300
CH-1211 Genève 2

Our ref.: W/IO/Q-INS-6 GENEVA, 2 July 1997

Annexes: 3 (available in English only)

Subject: Questionnaire on Instrument Development

Action required: The attached questionnaire to be completed and sent to the CIMO Rapporteur on Instrument Development as soon as possible but not later than **15 August 1997**

Dear Sir/Madam,

WMO and, in particular, its Commission for Instruments and Methods of Observation (CIMO), have been preparing publications on new developments in instrumentation and observational techniques for a long period of time. Since 1968 five editions of a series entitled "Instruments Development Inquiry" have been published. CIMO, at its eleventh session, agreed that it is important to keep this material up-to-date. To this end it was agreed to prepare the attached Questionnaire on Instrument Development. The intention is to compile the sixth edition of the "Instruments Development Inquiry" on the basis of the analysis of the information provided. It is planned to publish the new edition prior to the forthcoming session of CIMO in April 1998.

As this activity is included in the terms of reference of the CIMO Rapporteur on Instrument Development, Dr J.P. van der Meulen (Netherlands), you are kindly invited to send the completed questionnaire form(s) at your earliest convenience but not later than **15 August 1997** directy to:.

Dr J.P. van der Meulen
Rapporteur on Instrument Development
Royal Netherlands Meteorological Institute
Operational Observations
Postbus 201
3730 AE De Bilt
The Netherlands

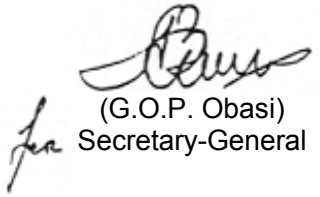
Explanations to assist in the completion of the questionnaire(s) are attached.

To: Permanent Representatives (or Directors of Meteorological or Hydrometeorological Services) of Members of WMO (PR-5364)

cc: President and vice-president of CIMO)
Presidents of other technical commissions) (for information)
Dr J.P. van der Meulen, Rapporteur on Instrument Development)

Since instrument development is often pursued outside national Meteorological Services, you are further kindly invited to distribute this letter and the attached questionnaire form to relevant institutions and manufacturers within your country.

Yours faithfully,



(G.O.P. Obasi)
Secretary-General