



OPERATIONAL ACCEPTANCE TEST REPORT

for

*Automated Surface Observing System
Ice-Free Wind Sensor and
Version 2.79/2.79A Acquisition
Control Unit Software*

September 2005

**U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service
Office of Operational Systems
Field Systems Operations Center
Test and Evaluation Branch**

Introduction and Background

Since 1992, Automated Surface Observing Systems (ASOS) have been equipped with the Belfort Model 2000 Digital Wind System for the measurement of wind speed and direction. The Model 2000 is a development of the Belfort F-420 wind system and has been adapted for use on ASOS. The Belfort Model 2000 measures wind speed using a rotating three-cup device and direction is measured with a vane assembly. Although the Model 2000 performs well in most conditions, freezing rain can slow or completely immobilize the cups and vane. For this reason, the National Weather Service (NWS) ASOS Planned Product Improvement (PPI) Program began an evaluation of the Vaisala/Handar Model 425NWS, an ultrasonic ice-free wind (IFW) sensor with no moving parts. Extensive testing of the IFW sensor at the Sterling Research and Development Center, Sterling, Virginia, confirmed the NWS wind measurement range/accuracy requirements are met. Other sensor testing, which has validated performance in real and simulated winter conditions, included environmental qualification testing (chamber testing performed by the Vaisala/Handar and witnessed by the Government) and field testing at non-operational sites (Sterling, Virginia; Johnstown, Pennsylvania; Duck Island, North Carolina; and St. Johns, Newfoundland). In addition to offering improved performance in freezing conditions, the IFW sensor can also be configured to provide three-second wind gusts as required by the World Meteorological Organization while the Model 2000 provides five-second gusts only.

The purpose of the Operational Acceptance Test (OAT) was to confirm satisfactory integration of the IFW sensor into ASOS at representative field sites and to evaluate its readiness for implementation. Since installation of the ASOS processor upgrade (the Synergy single-board processor) and modifications to the Acquisition Control Unit (ACU) software were required to support the IFW sensor, confirmation of overall ASOS performance with the revised ACU software [i.e. Version (V) 2.79/2.79A] was also an integral part of the OAT.

The OAT plan, “**OPERATIONAL ACCEPTANCE TEST PLAN for *Automated Surface Observing System (ASOS) Ice-Free Wind Sensor***” dated October 2002, can be found at:

http://www.nws.noaa.gov/ops2/ops24/documents/asos_docs.htm

This report summarizes the OAT test activities, test results, conclusions and recommendation of the ASOS Test Review Group (TRG).

Conduct of the OAT

The OAT sites were selected to provide a wide variety of ASOS configurations and operational scenarios. A total of 37 sites participated in the OAT:

Eastern Region

ACY Atlantic City, NJ
BTV Burlington, VT
CAR Caribou, ME
*IGX Chapel Hill, NC
*MDT Middletown, PA
PWP Portland, ME
RIC Richmond, VA

Western Region

BLU Emigrant Gap, CA
FCA Kalispell, MT
GEG Spokane, WA
*GGW Glasgow, MT
LLJ Challis, ID
*SFO San Francisco, CA
UAO Aurora, OR

Alaska Region

BRW Barrow, AK
KTN Ketchikan, AK
SIT Sitka, AK
TKA Talkeetna, AK

Central Region

ARR Chicago, IL
BFF Scottsbluff, NE
CMX Hancock, MI
GFK Grand Forks, ND
GRB Green Bay, WI
HUF Terre Haute, IN
*LXT Lee's Summit, MO
OSH Oshkosh, WI
TOP Topeka, KS

Southern Region

*BAZ New Braunfels, TX
EYW Key West, FL
FTW Fort Worth, TX
GUY Guyton, OK
NEW New Orleans, LA
*SRQ Sarasota, FL
TRI Bristol, TN

Pacific Region

* ITO Hilo, HI
** PGUM Guam
** PGSN Saipan

Legend

- Limited production and production IFW sensor (with V2.79)
- Production IFW sensor with V2.79A
- V2.79 evaluation only (no IFW sensor)
- V2.79A evaluation only (no IFW sensor)
- * single sensor site
- ** typhoon (high wind speed) site

During the OAT, limited production IFW sensors were evaluated at 22 sites with V2.79 ACU software and six additional sites evaluated only the V2.79 software. Production IFW sensors were evaluated at seven sites with V2.79A ACU software and two additional sites evaluated only the V2.79A software. Of the 29 IFW sensor sites, 21 used a dual wind sensor configuration with the IFW sensor installed in addition to the Belfort Model 2000. The V2.79/2.79A software allows the data from either wind sensor to be used operationally with the data from the other wind sensor being archived for analysis. Ten of the 21 dual sensor sites have been designated for participation in a Climate Data Continuity Study which is expected to last approximately two years and will be managed by the Observing Services Division (OS7).

During the course of the OAT, eight different ACU software versions were used at various times as software problems, related to the interfaces for the IFW sensor and the

All-Weather Precipitation Accumulation Gauge (AWPAG)*, were documented and fixed. The versions (detailed descriptions are provided in Appendix B) were:

V2.7A-1 (dated 08/09/02)
V2.7A-2 (dated 09/24/02)
V2.7A-3 (dated 10/22/02)
V2.7B-1 (dated 02/04/03)
V2.7B-3 (dated 03/20/03)
V2.7B-6 (dated 08/15/03)
V2.79 (dated 07/22/04)
V2.79A (dated 03/22/05)

The only difference between V2.79 and V2.79A is the addition of fixes for an ASOS clock problem noted at sites with an Federal Aviation Administration (FAA) ASOS Controller Equipment – Information Display System (ACE-IDS) interface and an observer password corruption problem noted at sites with backup ceilometers.

Although the evaluation documented in this report was performed only with V2.79/2.79A software, throughout the OAT, *changes in the ACU software versions did not affect performance of the IFW sensor or the sensor interface.*

Weekly OAT TRG conference calls were conducted to report the status of the OAT and to adjudicate problems. Minutes of these conference calls are available from the Office of Operational Systems, Field Systems Operations Center, Test & Evaluation Branch (OPS24).

The OAT was performed in two phases.

Phase 1 (began September 2, 2002, at BTV with V2.7A-1 ACU software)

The 22 dual sensor OAT sites were installed/configured with the Belfort Model 2000 as the operational sensor and the limited production IFW as a test sensor. Performance was evaluated, judged satisfactory, and, on April 25, 2003, the TRG authorized the Site Focal Points to begin Phase 2 by configuring the IFW as the primary sensor.

* The AWPAG OAT successfully concluded June 3, 2004. See the OAT report “**OPERATIONAL ACCEPTANCE TEST REPORT for Automated Surface Observing System (ASOS) All-Weather Precipitation Accumulation Gauge (AWPAG)**” dated July 2004:

http://www.nws.noaa.gov/ops2/ops24/documents/asos_docs.htm

Phase 2 (began April 28, 2003, at TOP with V2.7B-3 ACU software)

The IFW was configured as the operational sensor at the dual sensor sites and replaced the Model 2000 at the two single sensor sites (ITO and SFO). During Phase 2, the replacement of limited production IFW sensors with production sensors began (at TOP on September 21, 2004).

The statistics noted below and in Appendix A document evaluation with production IFW sensors configured as the primary wind sensor.

Evaluation with V2.79 ACU software began on September 7, 2004 (V2.79 software only at ACY). Evaluation with the production IFW sensor began on September 21, 2004, at TOP. More than 5200 site-days of evaluation (at 28 sites) was performed with V2.79 software. More than 3900 site-days of evaluation (at 22 sites) was performed with the production IFW as the primary wind sensor.

Evaluation with V2.79A ACU software began on April 4, 2005 (V2.79A software only at GRB). Evaluation with the production IFW sensor began on April 13, 2005, at SFO. A total of 329 site-days of evaluation (at nine sites) was performed with V2.79A software. A total of 256 site-days of evaluation (at seven sites) was performed with the production IFW as the primary wind sensor.

A chronology of OAT site installations is provided in Appendix A.

OAT Results

As stated in Part II, Section 3 of the OAT plan, the following items were evaluated at test objectives with these results:

Installation procedures and documentation - Draft Engineering Modification Notes (Mod Note) 77 (IFW sensor) and 80A (ACU software) were used for installations at the OAT sites. Minor changes were made to the documentation based on experience during the installations. Late in the OAT, the revised Mod Notes were used for installations at four additional sites (BAZ, GGW, IGX, and LXT) as a final confirmation; the Mod Notes were judged satisfactory. The V2.79 Release Note is posted on the Observing Systems Branch (OPS22) web site and was judged satisfactory. Release notes are not issued for new sensors.

The Operational Implementation Checklist (Part B) used to document installation of sensors/software and other OAT activities was judged satisfactory.

Interfacing with both NWS and non-NWS systems - All interfaces with NWS and non-NWS systems operated properly during the OAT. Proper FAA ACE-IDS display was confirmed by FAA tower staff. Runway Visual Range (RVR) from the FAA's New Generation Runway Visual Range (NGRVR) was correctly

incorporated into the ASOS METAR reports. Thunderstorm information from the FAA's Automated Lightning Detection and Reporting System (ALDARS) system was correctly incorporated into the ASOS METAR and SPECI reports.

Stable ASOS operation - During the evaluation period, stability of the OAT ASOSs was improved over past experience. In 329 cumulative site-days of V2.79A evaluation (at nine OAT sites), there were three warmstarts (two at SFO and one at BTV) and one coldstart (at RIC). The OAT warmstart frequency is well below the historical average (system-wide) of approximately one warmstart/site/month. The coldstart problem noted at one site has been determined to be ALDARS-related and is also present in all previous software versions for the upgraded processor. No ASOS observation/product availability problems were reported.

Production, transmission, and archiving of observations/products – The ASOS observations were representative of conditions and no problems were reported with the formatting, transmission, or archiving of the observations and products. During Winter 2004-2005, the ability of the IFW sensor to report wind speed and direction during freezing rain conditions was demonstrated at several sites.

Conclusions and Recommendation

The IFW sensor installation procedures (Mod Note 77), software installation procedures (Mod Note 80A), operator documentation (the V2.79 Release Note), and the Operational Implementation Checklist (Part B) were judged satisfactory by the Electronics Technicians, observers, and the OAT Site Focal Points. ASOS stability (with the IFW sensor and V2.79A ACU software) was improved over stability with previous software versions. ASOS functionality (production, transmission, and archival of observations as well as support of all ASOS interfaces) was judged satisfactory by the OAT participants.

At the June 2, 2005, conference call, based on the evaluation performed during the OAT, the TRG judged performance of the IFW sensor and ACU software satisfactory and recommended operational deployment of the production IFW sensors and V2.79A ACU software.

Although one spontaneous ACU coldstart occurred during the OAT at a site with the V2.79A ACU software and an ALDARS interface, it could not be confirmed as a software problem. Since the conclusion of the OAT, however, spontaneous ACU coldstarts have also been noted at several sites with V2.7B-6 software and an ALDARS interface. The ASOS software contractor has identified the problem in V2.7B-6 and confirmed that V2.79/2.79A sites with an ALDARS interface may experience spontaneous coldstarts as well.

Until ACU software with a fix for the coldstart problem is available, a phased approach to deployment of V2.79A has been adopted to allow installation of IFW sensors at sites

in Northern sites prior to winter. The initial deployment of V2.79A (without IFW sensors) will be to 35 FAA Service Level D (un-staffed) sites where observer training is not required. If software performance at the first 35 sites is acceptable (i.e., no ACU coldstarts), deployment of IFW sensors to those sites will be approved, along with deployment of IFW sensors and V2.79A to additional Level D sites. At the same time, deployment of IFW sensors and V2.79A software to selected Level A and B sites can begin although union notification and observer training will be required for those sites with FAA or contract observers.

OAT Site Installation Chronology**V2.79 and Limited Production IFW Sensors – Evaluation through June 2, 2005**

<u>Site</u>		<u>Installation</u>	<u>Days of Operation</u>
Atlantic City (ACY), NJ	WSP	09/07/04 – 04/25/05	230
Topeka (TOP), KS	IFW	09/21/04	246
Caribou (CAR), ME	IFW	09/23/04	244
Grand Forks (GFK), ND	IFW	09/30/04	237
Kalispell (FCA), MT	V2.79 only	10/13/04	224
Hancock (CMX), MI	IFW	10/18/04	219
Portland (PWM), ME	V2.79 only	10/18/04	219
Guymon (GUY), OK	V2.79 only	10/21/04	216
Oshkosh (OSH), WI	IFW	10/25/04	212
Key West (EYW), FL	IFW	10/28/04	209
Guam (PGUM)	IFW	10/28/04	209
Bristol (TRI), TN	V2.79 only	10/28/04	209
Spokane (GEG), WA	WSP	11/01/04	205
Aurora (UAO), OR	IFW	11/02/04	204
Saipan (PGSN)	IFW	11/03/04	203
Middletown (MDT), PA	IFW	11/08/04	198
Challis (LLJ), ID	IFW	11/12/04	193
Barrow (BRW), AK	IFW	11/16/04	191
Talkeetna (TKA), AK	IFW	11/18/04	188
New Orleans (NEW), LA	IFW	12/01/04	175
Fort Worth (FTW), TX	IFW	12/09/04	167
Chicago (ARR), IL	IFW	12/15/04	161
Terre Haute (HUF), IN	IFW	12/15/04	161
Emigrant Gap (BLU), CA	IFW	12/16/04	145
Sarasota (SRQ), FL	IFW	01/13/04	133
Scottsbluff (BFF), NE	IFW	02/02/05	113
Ketchikan (KTN), AK	IFW	02/15/05	100
Sitka (SIT), AK	IFW	03/16/05	78
Total Site-days of evaluation	V2.79 ACU software		5289
	Limited production IFW sensor		3986

V2.79A and Production IFW
Sensors – Evaluation through June
2, 2005

<u>Site</u>		<u>Installation</u>	<u>Days of Operation</u>
Green Bay (GRB), WI	password	04/04/05	59
San Francisco (SFO), CA	IFW/ACE-IDS	04/13/05	50
Glasgow (GGW), MT	IFW	04/14/05	49
Lee's Summit (LXT), MO	IFW	04/18/05	45
Chapel Hill (IGX), NC	IFW	04/26/05	37
Burlington (BTV), VT	IFW	04/28/05	37
New Braunfels (BAZ), TX	IFW	05/12/05	22
Hilo (ITO), HI	IFW	05/17/05	16
Richmond (RIC), VA	ACE-IDS	05/19/05	14
Total Site-days of evaluation	V2.79A ACU software		329
	Production IFW sensor		256

ACU Software Versions

- V2.7A-1 (dated 08/09/02) Adds support for the limited production IFW sensor
- V2.7A-2 (dated 09/24/02) Implements a warmstart fix
- V2.7A-3 (dated 10/22/02) Implements a fix for invalid IFW maintenance flags (“\$”) based on path errors
- V2.7B-1 (dated 02/04/03) Introduces AWPAG support
- V2.7B-3 (dated 03/20/03) Implements fixes for the IFW (path errors cause “\$”), IFW invalid maintenance flag (“\$”) problems, bird-induced gusts, the squall problem, the 1-minute delay in the IFW wind, problems with monthly summaries, and “phantom” data from de-configured IFW sensors
- V2.7B-6 (dated 08/15/03) Implements an ACU/DCP timing fix and ACE-IDS support
- V2.79 (dated 07/22/04) Introduces support for the production IFW sensors and a fix for inappropriate 5-MIN observations (noted in an earlier version)
- V2.79A (dated 03/22/05) Implements a fix for an ASOS clock problem at ACE-IDS sites and an improved fix for the 5-MIN observation problem