

Calibration Report: Wind Sensor

S/N: 19659

14 August 2008

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Science Systems and Applications, Inc.
Hampton, Virginia

Summary

Calibration date: 8 August 2008 Next Calibration date: 9 August 2009

A collection, analysis and calibration of data from a Wind Sensor instrument, S/N: 19659, has been completed. The calibration was performed by the wind sensor manufacturer, R.M. Young, Inc. These data were collected by R.M Young on 8 August 2008.

Model: 05103 (R.M Young)
Serial Number: 19659

The test data presented in chart and graphical format show the sensor to be within +/- 2 degrees in determining wind direction and azimuth. The report also states the wind sensor to be within +/- 0.3 m/s.

The following pages provide more detail into the calibration process and results.

Application: Standard Campbell data logger program for R.M. Young wind sensor.



Certificate No. 3989366

806 MIDDLE GROUND BLVD.
NEWPORT NEWS, VA 23606

**CERTIFICATE OF CALIBRATION
FOR
JACOBS SVERDRUP
LARC. 1 Enterprise Parkway Room 140
HAMPTON, VA 23666**

Description: **YOUNG, 05103-5, WIND MONITOR**

Serial No: **19659/45736**

Asset No: **A022968**

Simco ID: **40211-51862**

Dept: **1250-124B**

PO No: **AI00033**

Calibration Date: 08/14/08	Calibration Interval: 12 Months	Recall Date: 08/14/09
Arrival Condition: MEETS MANUFACTURER'S SPEC'S.		Service: CALIBRATED TO MFR SPEC,& CLEAN

Procedure: **O/S VENDOR**

Temperature: °F

Relative Humidity: %

Detail Of Work Performed:

Customer requested this item sent out for calibration to R.M. Young Company, a non-approved vendor. See attached.

There are 5 Supplementary Data Sheet(s) attached.

Work performed by: *W. Thrift*
William Thrift
Mechanical Tech C/QA Rep (13105)

Reviewed by: *[Signature]* 

SIMCO Electronics' quality management system conforms to ISO 9001:2000, ISO/IEC 17025:2005, and ANSI/NCSL Z540-1-1994. All calibrations are performed using internationally recognized standards traceable to the International System of Units (SI Units). Traceability is achieved through calibrations by the National Institute of Standards and Technology (NIST), other National Measurement Institutes (NMIs'), or by using natural physical constants, intrinsic standards or ratio calibration techniques. Instruments are calibrated with a test accuracy ratio of 4:1 or greater, otherwise measurement uncertainty analysis and/or guard bands are applied during the measurement process. The information shown on this certificate applies only to the instrument identified above and may not be reproduced, except in full, without prior written consent from SIMCO Electronics. There is no implied warranty that the instrument will maintain its specified tolerances during the calibration interval due to possible drift, environment, or other factors beyond our control.

Dated: **08/14/08**





R.M. Young Company
 2801 Aero Park Drive
 Traverse City, Michigan 49686 USA

CALIBRATION REPORT
Wind Speed

Customer: *Simco Electronics*

Test Number: 88141 Customer PO: R62271
 Test Date: 14 August 2008 Sales Order: 9959

Test Sensor:
 Anemometer: 05103-5 Wind Monitor Propeller: 08234
 Serial Number: 19659 Serial Number: 45736

Report of calibration comparison with National Institute of Standards and Technology calibrated anemometer in the R.M. Young Company 50 x 75 cm rectangular test section open return wind tunnel. The following data describe the relationship between test section wind speed, as determined by the NIST calibrated standard anemometer, and test anemometer rpm, as determined by its output. Indicated wind speed is calculated using anemometer's published formula.

Wind Speed According to Standard Anemometer		Wind Speed According to Test Anemometer			
Model:	05103 / 08234	Anem:	05103-5	Prop:	08234
Serial #:	00005	Serial #:	19659	Serial #	45736
Nominal Speed m/s	Actual Speed m/s (1)	100 Second Pulse Count	Output Frequency	Propeller RPM (2)	Indicated Speed m/s (3)
30	30.3	30870	308.7	6174	30.3
25	25.3	25735	257.4	5147	25.2
20	20.2	20522	205.2	4104	20.1
16	16.2	16394	163.9	3279	16.1
14	14.1	14322	143.2	2864	14.0
12	12.1	12275	122.8	2455	12.0
10	10.1	10195	102.0	2039	10.0
8	8.1	8132	81.3	1626	8.0
6	6.1	6060	60.6	1212	5.9
5	5.0	5011	50.1	1002	4.9
4	4.0	3976	39.8	795	3.9
3	3.0	2937	29.4	587	2.9
2	2.0	1886	18.9	377	1.8
1	1.0	782	7.8	156	0.8

National Institute of Standards and Technology Reference

Calibrated Standard Anemometer (4)
 Test #: TN251034
 Date: 9 Nov 1992
 Model: 08234 Serial #: 00005

Environmental Conditions

Barometric Pressure (hPa): 990
 Temperature (C): 24.5
 Relative Humidity (%): 62.0

- (1) Actual wind speed determined by relationship between tunnel fan rpm and NIST calibrated standard propeller rpm.
- (2) Wind Monitor output is three (3) pulses per revolution: $Rpm = Hz / 3 \times 60 \text{ sec}$.
- (3) Published calibration: Wind speed (m/s) = 0.00490 x propeller rpm.
- (4) NIST Calibration accuracy is within 1%.

Tested By *EChamney*



R.M. Young Company
 2801 Aero Park Drive
 Traverse City, Michigan 49686 USA

CALIBRATION REPORT

Wind Speed (page 2)

Test Number: 88141

Linear Regression

A linear regression is performed on the calibration data to determine the best fit straight line representing the relationship between propeller rpm and actual wind speed as determined by the NIST calibrated standard anemometer.

Slope: 0.00488 meters per second per RPM
 Intercept: 0.16 meters per second
 Pitch: 29.29 centimeters per revolution
 Correlation Coefficient: 0.99999

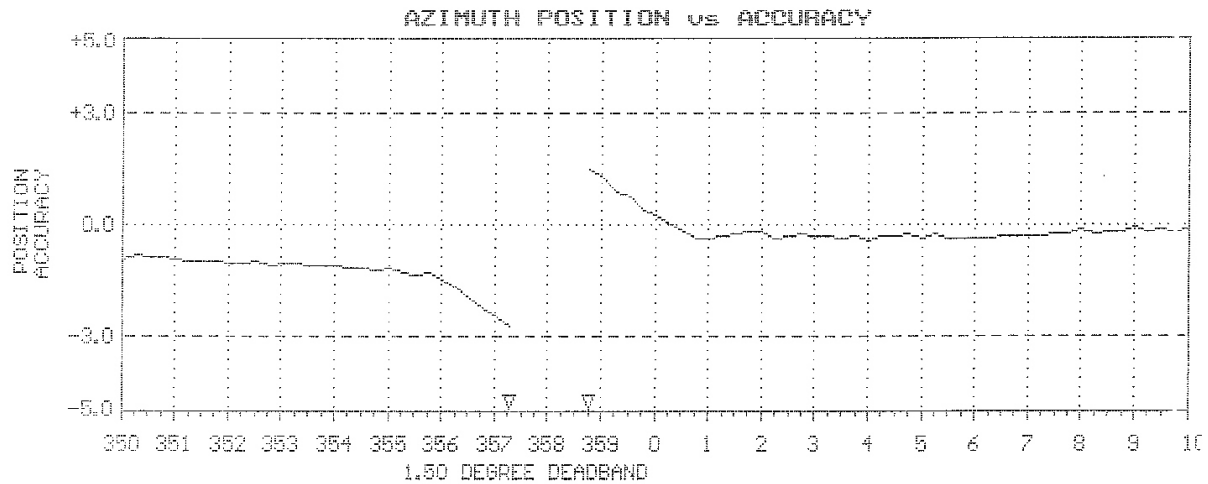
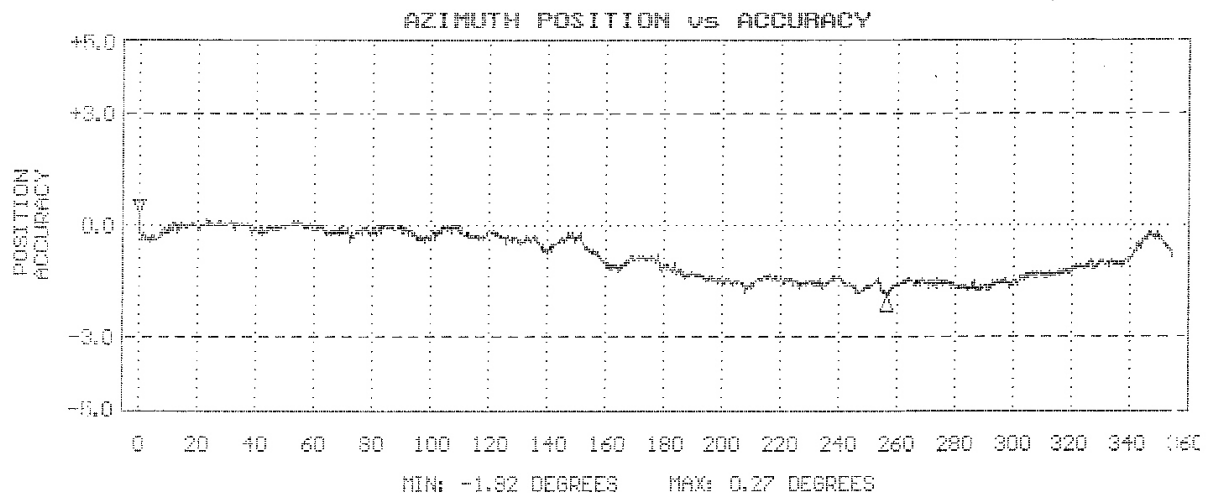
Wind Speed =	Slope	x RPM +	Intercept	Slope	x Hz +	Intercept
m/s	= 0.00488	x RPM +	0.16	0.09763	x Hz +	0.16
mph	= 0.01092	x RPM +	0.35	0.21838	x Hz +	0.35
knots	= 0.00948	x RPM +	0.31	0.18964	x Hz +	0.31
km/hr	= 0.01757	x RPM +	0.57	0.35145	x Hz +	0.57

Threshold Measurements

	New Instrument	As Found	As Left
Start:		0.7 m/s	0.6 m/s
Stop:	n/a	0.4 m/s	0.4 m/s

R. M. YOUNG COMPANY WIND SENSOR CALIBRATION CERTIFICATE

SENSOR: 05103-5 WIND MONITOR
SENSOR SERIAL NUMBER: 19659
BEARINGS: SEALED/GREASE LUBE
DATE: AUG 14 2008
WIND SPEED THRESHOLD TEST: PASS
LOW WIND SPEED AMPLITUDE/FREQUENCY TEST: PASS
HIGH WIND SPEED AMPLITUDE/FREQUENCY TEST: PASS
VANE TORQUE TEST: PASS
SPECIAL NOTES:
SPECIAL NOTES:



NOTE: Azimuth Position vs Accuracy graphs are accurate to within 0.5 degrees. The accuracy shown in the potentiometer deadband region between 355 and 0 degrees is the result of no resistance change while position changes. The gap represents the actual deadband (open circuit).

05103, 05106, and 05305 R.M. Young Wind Monitors

1. General Description

The 05103, 05106, and 05305 Wind Monitor sensors are used to measure horizontal wind speed and direction. The 05305 is a high performance version of the 05103 designed to meet PSD specifications for air quality applications. The 05106 is recommended for marine applications.

Wind speed is measured with a helicoid-shaped, four-blade propeller. Rotation of the propeller produces an AC sine wave signal with frequency proportional to wind speed.

Vane position is transmitted by a 10K ohm potentiometer. With a precision excitation voltage applied, the output voltage is proportional to wind direction.

The R.M. Young Instruction Manual includes additional information on the operating principles, installation and maintenance of the sensor.

Lead length for the Wind Monitor is specified when the sensor is ordered. Table 1-1 gives the recommended lead length for mounting the sensor at the top of the tripod/tower with a 019ALU or CM200 series crossarm.

TABLE 1-1. Recommended Lead Lengths							
CM6	CM10	CM110	CM115	CM120	UT10	UT20	UT30
10'	13'	13'	19'	24'	13'	24'	34'

The 05103 / 05106 / 05305 ships with:

- (1) Allen wrench from mfg
- (1) Bearing spacer from mfg
- (1) Calibration Sheet
- (1) Instruction Manual
- (1) 3659 Mounting pipe

2. Specifications

	<u>05103 and 05106</u>	<u>05305</u>
Wind Speed		
Range:	0-224 mph (0-100 m s ⁻¹)	0-112 mph (0-50 m s ⁻¹)
Accuracy:	±0.6 mph (±0.3 m s ⁻¹) or 1% of reading	±0.4 mph (±0.2 m s ⁻¹) or 1% of reading
Starting threshold:	2.2 mph (1.0 m s ⁻¹) 05103; 2.4 mph (1.1 m s ⁻¹) 05106	0.9 mph (0.4 m s ⁻¹)
Distance constant (63% recovery):	8.9 ft (2.7 m)	6.9 ft (2.1 m)

	<u>05103 and 05106</u>	<u>05305</u>
Output:	ac voltage (3 pulses per revolution). 1800 rpm (90 Hz) = 19.7 mph (8.8 m s ⁻¹)	ac voltage (3 pulses per revolution) 1800 rpm (90 Hz) = 20.6 mph (9.2 m s ⁻¹)
Wind Direction		
Range:	0-360° mechanical, 355° electrical (5° open)	Same
Accuracy:	±3°	±3°
Starting threshold at 10° displacement:	2.4 mph (1.1 m s ⁻¹)	1.0 mph (0.5 m s ⁻¹)
Delay distance (50% recovery):	4.3 ft (1.3 m)	3.9 ft (1.2 m)
Damping ratio:	0.3	0.45
Damped natural wavelength:	24.3 ft (7.4 m)	16.1 ft (4.9 m)
Undamped natural wavelength:	23.6 ft (7.2 m)	14.4 ft (4.4 m)
Output:	Analog dc voltage from potentiometer – resistance 10 kΩ, linearity 0.25%, life expectancy 50 million revolutions.	Same
Power	Switched excitation voltage supplied by the datalogger.	Same
Physical		
Operating Temperature	-50° to +50°C, assuming non-riming conditions	-50° to +50°C, assuming non-riming conditions
Dimensions		
Overall:	14.6" H x 21.7" L (37 cm x 55 cm)	15.0" H x 25.6" L (38 cm x 65 cm)
Main housing Diameter:	2.0" (5 cm)	Same
Propeller Diameter:	7.1" (18 cm)	7.9" (20 cm)
Mounting Pipe:	1.34" (34 mm) OD; standard 1.0" IPS schedule 40	Same
Weight (shipping approx.)	3.2 lbs (5.5 lbs); 1.5 kg (2.3 kg)	2.5 lbs (5.5 lbs); 1.1 kg (2.3 kg)

Manufactured by RM Young (Traverse City, MI) and cabled by Campbell Scientific for use with our dataloggers.