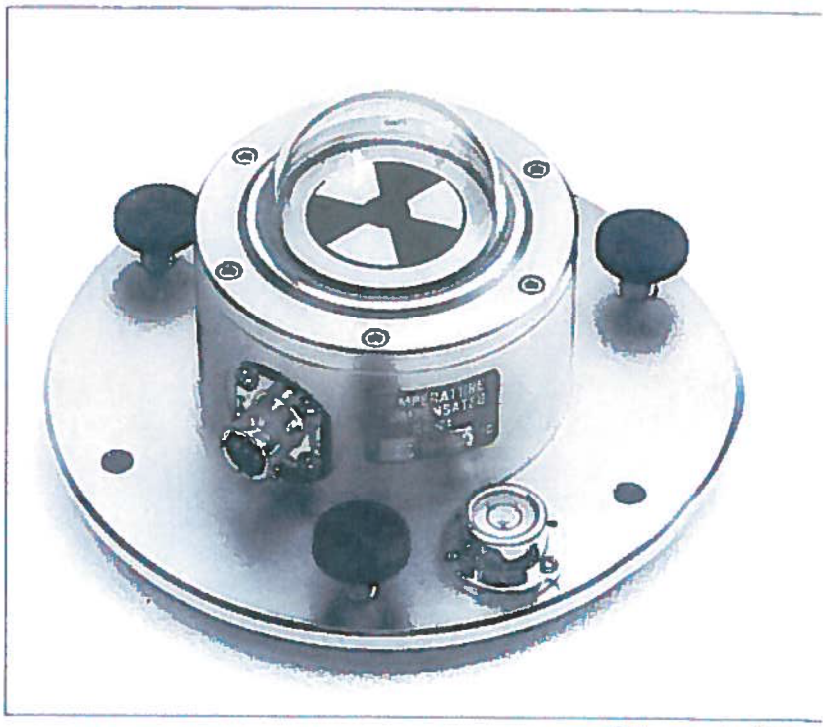
Attachment G

Technical Specifications for Towers

(120 pages)

Solar Radiation Sensors

Solar energy is a significant element in large-scale atmospheric motion, and as a result it has an important place in meteorology. It is directly related to atmospheric stability, and is used in determining stability classes for pollution studies. Met One Instruments supplies solar sensors to meet virtually any monitoring requirement.



Model 095

Model 095 Pyranometer

The Model 095 Pyranometer incorporates a multi-junction differential thermopile and a precision ground optical glass hemisphere which is transparent to wave lengths 0.285 to 2.80 microns. It is used for high-precision, broad-band measurements of incident solar radiation.

Features

- Differential thermopile detector
- High accuracy, broad bandwidth
- Temperature compensated
- Rapid response time
- Built-in leveling devices

The detector element is of wirewound-plated construction with black and white segments. When exposed to solar radiation the differing absorptivity of the black and white surfaces develops a temperature differential. The thermopile then produces a voltage proportional to the solar radiation. Built in thermistor circuitry is incorporated to eliminate the effects of ambient temperature.

The single hemispherical optical glass dome has a waterproof seal, but can easily be removed for repairs. The case is cast aluminum, painted white, and is fitted with a desiccator, circular level, and leveling screws. A mounting base with a vertical 3/4" IPS pipe simplifies field installation of the sensor. This rugged instrument is capable of withstanding mechanical vibrations of up to 20 G's.

Met One Instruments, Inc.

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Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Solar Sensor Specifications

	Model 095	Model 394	Model 096	Model 097
Spectral Response				
nanometers	285 to 2800	285 to 2800 (clear)*	400 to 1100	250 to 60000
microns	0.28 to 2.80	0.28 to 2.80 (clear)	0.4 to 1.1	0.25 to 60
Calibration	Integrating hemisphere approx. 1 cal cm^{-2} min^{-1}, at 25°C	Integrating hemisphere approx. 1 cal cm^{-2} min^{-1}, at 25°C	against Eppley B&W under natural daylight	against transfer standard and compared to a tungsten-halide light source
Sensitivity**	11 mV/kwatt $meter^{-2}$, approx.	9 mV/kwatt $meter^{-2}$, approx.	8.0 mV/kwatt $meter^{-2}$ with 100 Ohm load, approx.	75 mV/kwatt $meter^{-2}$, approx.
Impedance	350 Ohms, approx.	650 Ohms	100 Ohm load (dependent upon sensor sensitivity)	4 Ohms
Temperature Dependence	±1.5% constancy from -20 to +40° C	±1% constancy from -20° to +40° C	±0.15%/degree C, maximum	N/A
Linearity	±1% from 0 to 1400 watts $meter^{-2}$	±0.5% from 0 to 2800 watts $meter^{-2}$	±1% from 0 to 3000 watts $meter^{-2}$	N/A
Response time	5 seconds (1/e signal)	1 second (1/e signal)	10 microseconds (10% to 90%)	10.5 seconds
Cosine Response	±2% from normalization 0°-70° zenith angle; ±5% 70°-80° zenith angle	±1% from normalization 0°-70° zenith angle ±3% from 70°-80° zenith angle	Corrected up to 82° incident angle. Azimuth error less than 1% over 360° at 45° elevation	N/A
Physical				
Size (including mount)	5.75" dia. x 21" H	5.75" dia. x 23" H	3" dia. x 19" H	2.8" W x 2.5" H x 37" L
Weight (including mount)	4 lbs (1.8 KG)	9 lbs (4 KG)	1.2 lbs (.54 KG)	3 lbs (1.3 KG)
Mounting	Leveling plate and mounting base included Requires #1552 fitting or similar device	Leveling plate and mounting base included Requires #1552 fitting or similar device	Leveling plate and mounting base included Requires #1552 fitting or similar device	Mounting plate for support arm included
Cable (xx = length in feet)	#1138-xx	#1138-xx	#1832-xx	#2437-xx

* Contact factory for other ranges.

** Sensitivity varies among sensors of the same type. A Calibration Certificate is supplied with each sensor.

MODEL 96-1
SOLAR RADIATION SENSOR

OPERATION MANUAL

Met One
Instruments

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096-1 SOLAR RADIATION SENSOR

1.0 GENERAL INFORMATION

1.1 The Model 096-1 Solar Radiation Sensor is an accurate and sensitive sensor using a Li-COR sensing element and designed for the continous measurement of solar radiation. Typically, the sensor is mounted with the 1289 Mounting Plate.

1.2 Spectral Response. The relative spectral response of the silicon photodiode does not extend uniformly over the full solar radiation range. A typical response curve is presented in Figure 1.1. The response is very low at 0.4 μm and then increases nearly linear to a cutoff near 1.1 μm. Changes in the spectral distribution of the incident light, coupled with the non-uniform spectral response, can cause errors in the photodiode output. Hull[3] shows that in the 0.4 to 0.7 μm range, the spectral distribution of sun plus sky radiation on a horizontal surface is remarkably constant even when clear and overcast days are compared. However, Gates[2] indicates that the major change in spectral distribution of solar radiation occurs in the near infared where water vapor absorption takes place on cloudy days. Data collected at low solar elevations can show significant error because of altered spectral distribution which changes in atmospheric transmission. This is a small part of the daily total so the possible observed error usually has an insignificant effect on daily integrations.

The area under the spectral irradiance curve of the source is directly porportional to the energy received by a horizontal surface. Under specific but typical conditions, energy received on a completely overcast day has been estimated to be 11.3% of that received on a clear day. When both spectral distributions are weighted according to a typical response curve of a silicon photodiode, the response on this cloudy day is 12.6%. Therefore, errors incurred under different sky conditions, due to the spectral response of the photodiode, will be small. The field tests of Federer and Tanner[1] and Kerr, Thurtell and Tanner[4] confirm this conclusion.

1.3 Calibration. The 096-1 Pyranometer has been calibrated against an Eppley Precision Spectral Pyramonmeter (PSP) of which the calibration is periodically confirmed. The calibration was performed under daylight conditions by a computer sampling of instantaneous readings from the Eppley and Li-COR pyranometers. Instantaneous readings were taken continuously for 10 minutes and then averaged. Sequential ten minute averaging periods were run from sunup to sundown for 3-4 days. These ten minute averages were then evaluated and used to compute an average calibration constant. The uncertainty of calibration is ± 5%.

Table 1-1
Model 096-1 Solar Radiation Sensor Specifications

Calibration	Calibrated against an Eppley Pyranometer under natural daylight clear conditions. Absolute accuracy under these conditions is ±5%. All sensors are calibrated to within 1% of each other.

Sensitivity	Typically 80 microamp/1000 watts m^{-2}.
Linearity	Maximum deviation of 1% to 3000 watts m^{-2}.
Stability	Less than 2% change over a 1 year period.
Response Time (10-90%)	10 microseconds
Temperature Dependence	± .15% per °C maximum
Cosine Correction	Cosine corrected up to 82° angle of incidence.
Azimuth Error	Less than 1% over 360° at 45° elevation.
Sensor Case	Weather-proof anodized aluminum case with diffuser and stainless steel hardware. Precision level supplied.
Mounting	A 1289 Mounting Plate is provided.

2.0 INSTALLATION

2.1 096-1 Solar Radiation Sensor Installation

A. Typically, the sensor is mounted to the 1289 Mounting Plate. Refer to Figure 2-1. Using a 1552 Mounting Clamp, the radiation sensor and mounting plate may be directly mounted to Met One Instruments' Model 191 Mounting Arm, or similar.

B. For proper operation it is necessary that the sensor be level. Level the sensor using the three outer screws. Lock into place using three inner screws.

C. The sensor is supplied with an attached 1832 cable. The white or red wire is the + signal. The black wire is the common.

3.0 096-1 SOLAR RADIATION SENSOR CHECK-OUT

3.1 Model 096-1 Solar Radiation Sensor has been calibrated at the factory. It will not change unless it is damaged. To check for proper operation of the sensor, expose the sensor to bright sunlight and check datalogger or translator for reasonable output, and then completely cover the sensor with a black tape and check for an output of near zero.

3.2 When this sensor is used with a Met One Instruments translator, the translator calibration is matched to the individual sensor. If used with dataloggers or other recording devices the use of a terminating resistor is required.

3.3 Terminating Resistor

A. The resistor is used to convert the current output signal to a voltage output signal, and is required when the sensor is connected to millivolt recording devices.

B. A precision 100Ω or150Ω resistor has been supplied with the sensor to allow for the correct interface between the sensor and millivolt recording electronics (not required when the 096-1 is used with the Met One Instruments Translator circuit cards). Place this resistor in parallel with the signal leads from the sensor. The output signal is then equal to:

Mv = I * R
Where:
Mv = Output microvolts
I = Output signal in microamps
R = Resistance in ohms of terminating resistor

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*

A. Inspect sensor for proper operation as per Section 3.0.

B. Clean sensor element monthly using clean rag or tissue.

*Schedule is based on average to adverse environments.

REFERENCES

1. Federer, C.A., and C.B. Tanner,1965. A simple integrating pyranometer for measuring daily solar radiation. J. Geophys, Res. 70, 2301-2306.
2. Gates, D.M.,1965. Radiant energy, its receipt and disposal. Meteor. Monogr.,6,No.28, 1-26.
3. Hull,J.N.,1954. Spectral distribution of radiation from sun and sky. Trans.Illun.Eng. Soc.(London),19:21-28.
4. Kerr, J.P.,G.W Thurtell, and C.B. Tanner,1967. An integrating pyranometer for climatological observer stations and mescoscale networks. Journal of Applied Meteorology,6,688-0694.

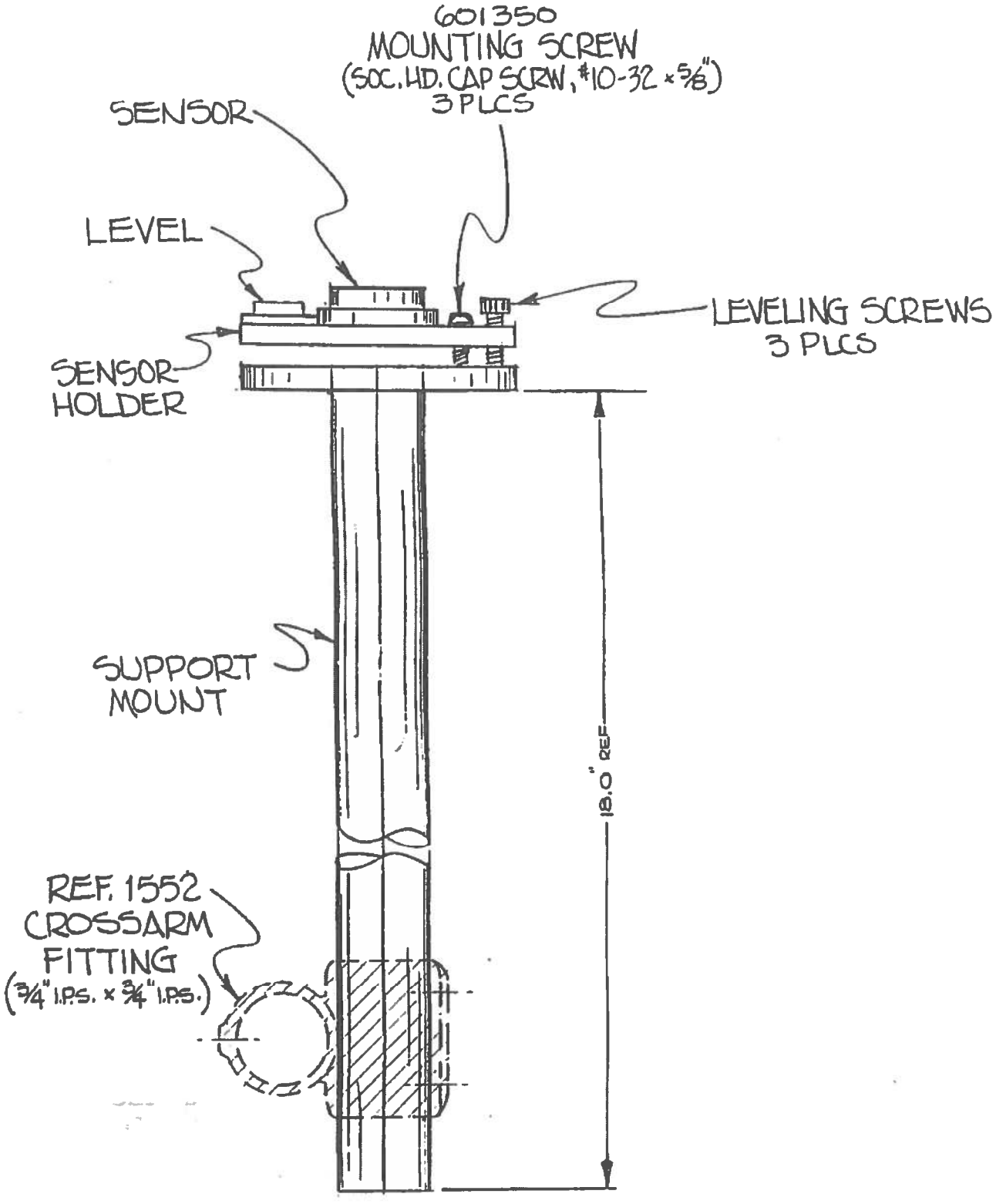


FIGURE 2-1
096-1 WITH 1289 SUPPORT MOUNT

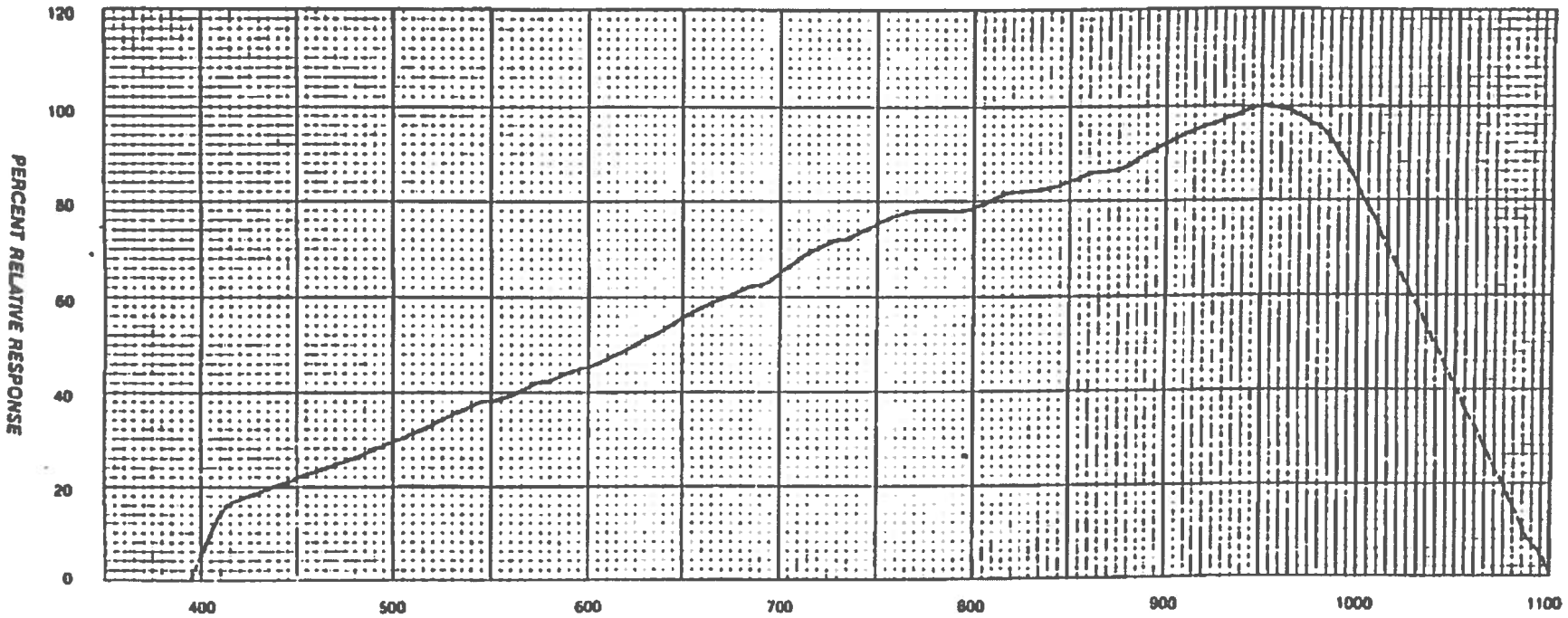
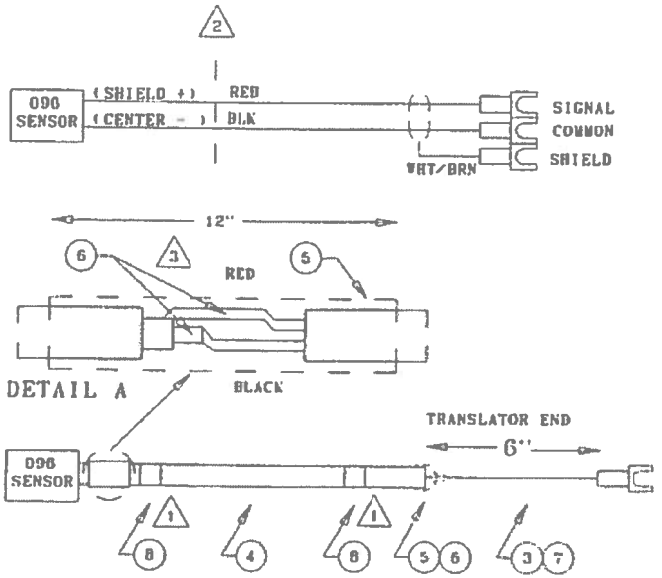

120
100
80
60
40
20
0
PERCENT RELATIVE RESPONSE
400
500
600
700
800
900
1000
1100
WAVELENGTH—NANOMETERS

FIGURE 1-1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN W/PARTS LIST	9/16/91	DH



ITEM	PART NO.	DESCRIPTION	QTY
1			
2			
3	600103	LUG, SPADE, #6	3
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	900050	SLEEVING, 1/4", SHRINK	12"
6	900075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	900060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET.
2. SPLICE 1832 CABLE TO 096 SENSOR CABLE AS SHOWN IN DETAIL A.
3. COVER EACH WIRE SPLICE SEPARATELY.

MET ONE INSTRUMENTS

ASSY, CABLE, 096
SOLAR RADIATION

SIZE	FSCM NO.	DWG NO	REV
		1832	C

SCALE | SHEET 1 OF 1

Wind Speed Sensor

014A

The Model 014A Wind Speed Sensor is an accurate, durable, and economical anemometer suitable for a wide range of wind study applications. It is designed for long term unattended operation in most meteorological environments.

Features

- Range to 100 mph
- Low starting threshold
- Broad temperature operating range
- Accuracy of ±1.5%
- Stainless steel and aluminum construction

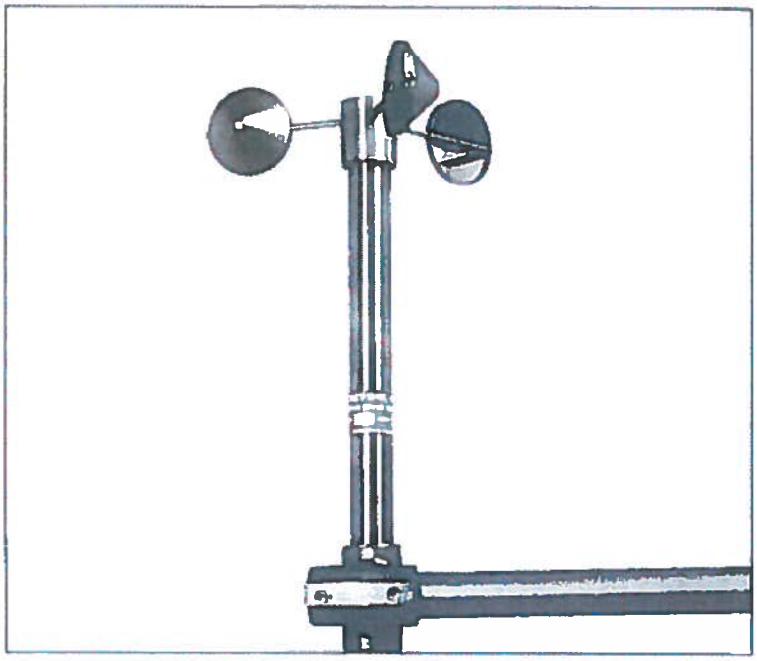
Operation

For maximum operational reliability, the sensor uses a sealed magnetic read switch. This switch produces a series of contact closures at a rate proportional to wind speed. With its pulsed output, the Model 014A lends itself to applications involving both digital and analog measurement systems.

The pulsed signal may be converted to standardized analog voltage and/or current output by use of translator electronics. Direct connection to a datalogger is also possible. The robust aluminum cup assembly normally supplied has a distance constant of <15 feet. For greater sensitivity, the optional Lexan plastic cup assembly may be specified, which has a distance constant of <5 feet.

Construction

The construction of the sensor reflects the requirement for reliability and durability. Only the best corrosion resistant materials, such as stainless steels and anodized aluminum are used. The Model 014A sensor uses a quick-connect sensor cable. Cable length may extend hundreds of feet without affecting measurement performance.



Accuracy, reliability and economy make the Model 014A Wind Speed Sensor an ideal choice for most applications.

Specifications

Range	0-100 mph
Starting threshold	1 mph
Accuracy	±.25 mph or 1.5% FS
Distance Constant	
Standard	<15 feet (Metal Cup Assy)
Fast Response	<5 feet (Lexan Cup Assy)
Operating Range	-50° C to +70° C
Contact Rating	10 mA maximum
Weight	11 ounces
Mounting	Model 191 Cross Arm

Ordering Information

Standard Model	014A (Metal Cup)
Fast Response Model	014A-1 (Lexan Cup)
Cable	#1805-xx (xx = length in feet)

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MODEL 014A
WIND SPEED SENSOR

OPERATION MANUAL
Document No. 014A-9800

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014A WIND SPEED SENSOR

1.0 GENERAL INFORMATION

1.1 The Met One 014A Wind Speed Sensor uses a durable 3-cup anemometer assembly and simple magnet-reed switch assembly to produce a series of contact closures whose frequency is proportional to wind speed. This sensor is usually used in conjunction with the 191 Crossarm Assembly and a translator module, but may also be used directly with a variety of dataloggers.

1.2 Sensor Cable has a quick-connect connector with vinyl-jacketed, shielded cable. Cable length is given in -XX feet on each cable part number.

Table 1 - 1
Model 014A Wind Speed Sensor Specifications

Performance Characteristics

Maximum Operating Range	0-60 meters/sec or 0-125 mph
Starting Speed	.5 meters/sec or 1 mph
Calibrated Range	0-50 meters/sec or 0-100
Accuracy	±1.5% or 0.25 mph
Temperature Range	-50° C to 85° C
Distance Constant*	
Standard (1812 Aluminum Cup Assembly)	Less than 15 feet
Optional (1708 Lexan Cup Assembly)	Less than 5 feet

*The distance traveled by the air after a sharp-edged gust has occurred for the anemometer rate to reach 63% of the new speed.

Electrical Characteristics

Output Signal	Contact closure at frequency V= (f x 1.7892) + 1 mph

Physical Characteristics

Weight	1.5 lbs.
Finish	Anodized
Mounting Fixtures	Use with 191 Crossarm
Cabling	2-Conductor Cable, XX is cable length in feet

Optional Accessories
(a)1708 Lexan Cup Assembly, Fast Response Type

2.0 INSTALLATION

2.1 014A Wind Speed Sensor Installation

A. Check to see that the cup assembly rotates freely (threshold, bearing check).

B. Install the sensor into the fitting on the end of the 191 mounting arm. (THE END WITHOUT THE ALIGNMENT BUSHING) Install just deep enough to allow cable connection. (Reference the mounting detail in Figure 2-1).

C. Apply a small amount of silicone grease to the set screws to prevent 'freezing up' in corrosive environments. Tighten the locking set screws--do not over tighten.

D. Connect the Cable Assembly to the connector receptacle on base of sensor. Secure the cable to the mounting arm using cable ties or tape.

2.2 Wiring

The Cable Assembly contains three wires.

Black	=	Signal
Red	=	Common
White/Brn	=	Cable Shield

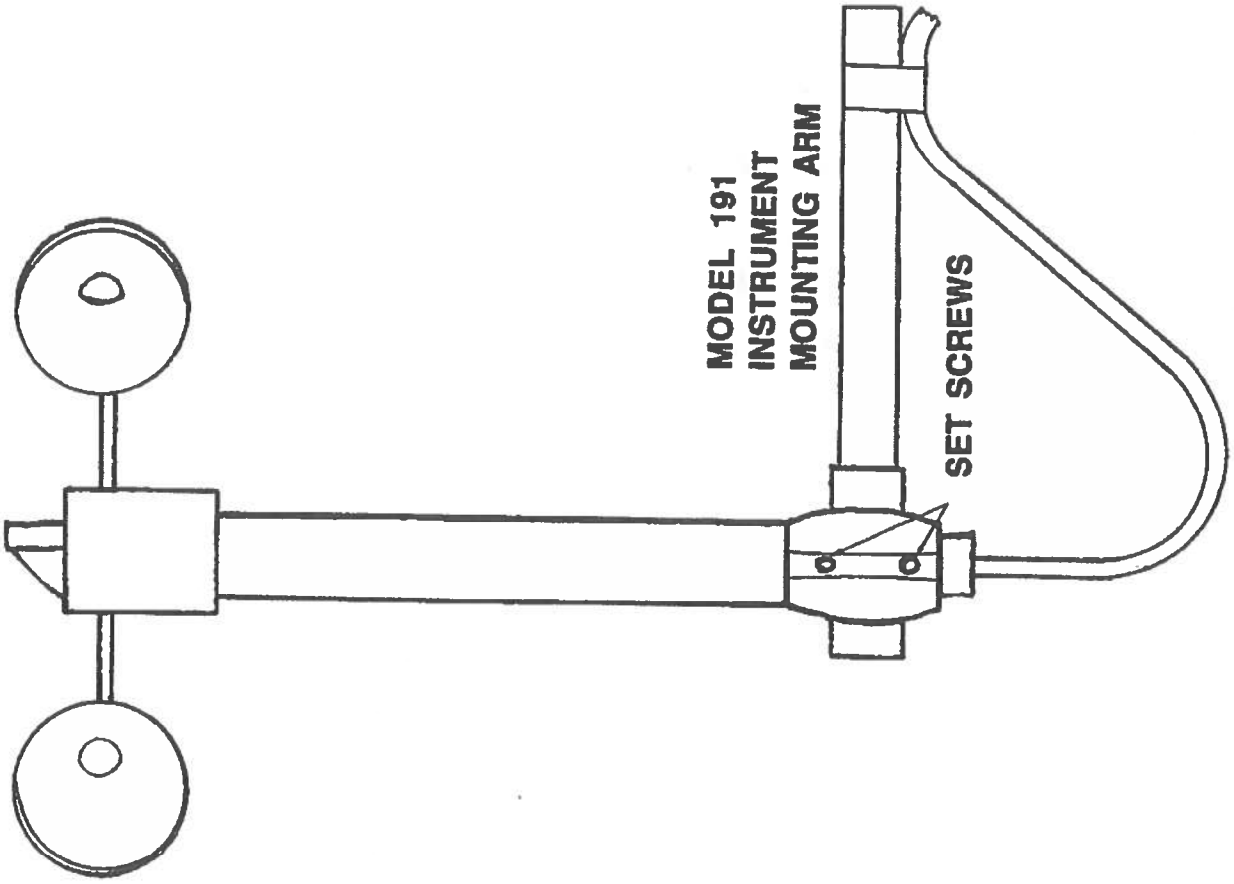


FIGURE 2-1

TABLE 3-1

MODEL 014A WIND SPEED SENSOR CALIBRATION

WIND VELOCITY VS OUTPUT FREQUENCY

Speed in Miles/Hr

V mph	RPS	F hz
10	2.515	5.030
20	5.310	10.619
30	8.104	16.208
40	10.899	21.797
50	13.693	27.386
60	16.488	32.975
70	19.282	38.564
80	22.077	44.153
90	24.871	49.742
100	27.666	55.331
110	30.460	60.920
120	33.255	66.509

SPEED IN METERS/SEC

V mps	RPS	F hz
2.5	1.284	2.567
5	2.846	5.693
7.5	4.409	8.819
10	5.972	11.945
12.5	7.535	15.071
15	9.098	18.197
17.5	10.661	21.323
20	12.224	24.449
22.5	13.787	27.575
25	15.350	30.701
27.5	16.913	33.827
30	18.476	36.953
32.5	20.039	40.079
35	21.602	43.205
37.5	23.165	46.331
40	24.728	49.457
42.5	26.291	52.583
45	27.854	55.709
47.5	29.417	58.835
50	30.980	61.961
52.5	32.543	65.087
55	34.106	68.212
57.5	35.669	71.338
60	37.232	74.464

RPM VS WIND SPEED

RPM	MPS	MPH	F hz
100	3.113	6.964	3.333
200	5.779	12.928	6.667
*300	8.446	18.892	10.000
400	11.112	24.856	13.333
500	13.778	30.820	16.667
*600	16.444	36.785	20.000
700	19.110	42.749	23.333
800	21.777	48.713	26.667
900	24.443	54.670	30.000
1000	27.109	60.641	33.333
1100	29.775	66.605	36.667
1200	32.441	72.569	40.000
1300	35.108	78.533	43.333
1400	37.774	84.497	46.667
1500	40.440	90.461	50.000
1600	43.106	96.426	53.333
1700	45.772	102.390	56.667
*1800	48.438	108.354	60.000

* STANDARD CALIBRATOR TEST POINTS

$$V\ mph = \frac{RPM}{16.767} + 1$$

$$V\ mps = \frac{RPM}{37.5067} + .44704$$

Based on equation f= .5589 (V-1)
where f is the output frequency.
V is wind speed miles per hour.
RPS = cup revolution per second.
1 MPH = 0.44707 meters/sec

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 014A Wind Speed Sensor Check-Out

A. Spinning the anemometer cup assembly will produce a series of pulses. To verify sensor output, monitor this signal with either a plug-in Translator Module, Datalogger or an Ohmmeter. Refer to Frequency vs. Wind Speed Table 3-1. Spin slowly and monitor output signal. A windspeed calibrator may be used to check operation at different RPM points.

B. Inspect the cup assembly for loose cup arms or other damage. The cup assembly cannot change calibration unless a mechanical part has come loose or has been broken.

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*

6-12 month intervals:

A. Inspect sensor for proper operation per Section 3.0.

B. Replace Wind Speed Sensor bearings in extremely adverse environments per Section 4.6.

12-24 month intervals:

A. Replacement of sensor bearings.

24-36 month intervals:

A. Recommended complete factory overhaul of sensor.

*Schedule is based on average to adverse environments.

Table 4-1

TROUBLESHOOTING TABLE

Symptom	Probable Cause	Remedy
No sensor output	Faulty reed switch	Replace reed switch
No sensor ouput	Faulty bearings	Replace bearings
No sensor ouput	Faulty cable	Check Connections

4.3 014A Wind Speed Sensor: 6-12 Month Periodic Service

A. At the crossarm assembly, disconnect the Sensor Cable from the Sensor (leave the cable secured to the crossarm) and remove the Sensor from the fitting on the crossarm assembly.

B. Loosen the two set screws on the side of the hub and remove the anemometer cup assembly.

C. Visually inspect the anemometer cups for cracks and breaks and make sure that each is securely attached to the cup assembly hub.

D. Inspect the Sensor for any signs of corrosion and dust buildup.

E. Rotate the Sensor hub assembly to make sure that it turns freely and that the Sensor bearings are not damaged. Make sure that the magnet assembly is not contacting the reed switch. (Ref. Fig. 4.1).

F. A moisture drain vent is located on the base of the Sensor. Make sure that this vent is clear.

G. Re-install Sensor as per installation procedure (Section 2.0) and verify proper operation using procedures in Section 3.0.

4.4 014A Wind Speed Sensor General Assembly (refer to 014A Assembly Drawing)

The following steps cover basic disassembly:

A. At the crossarm assembly, disconnect the Sensor Cable from the Sensor (leave the cable secured to the crossarm) and remove the Sensor from the crossarm assembly.

B. Loosen the two set screws and remove the anemometer cup assembly.

C. Remove the three (3) flathead screws at the top of the Sensor and lift out the bearing mount assembly, taking care not to break the wires.

4.5 Reed Switch Replacement Procedure

Use the following procedure to replace Sensor Reed Switch:

A. Remove bearing mount assembly as per Section 4.4.

B. Unsolder the leads of the Reed Switch (10) and remove the switch from the two mounting terminals (13).

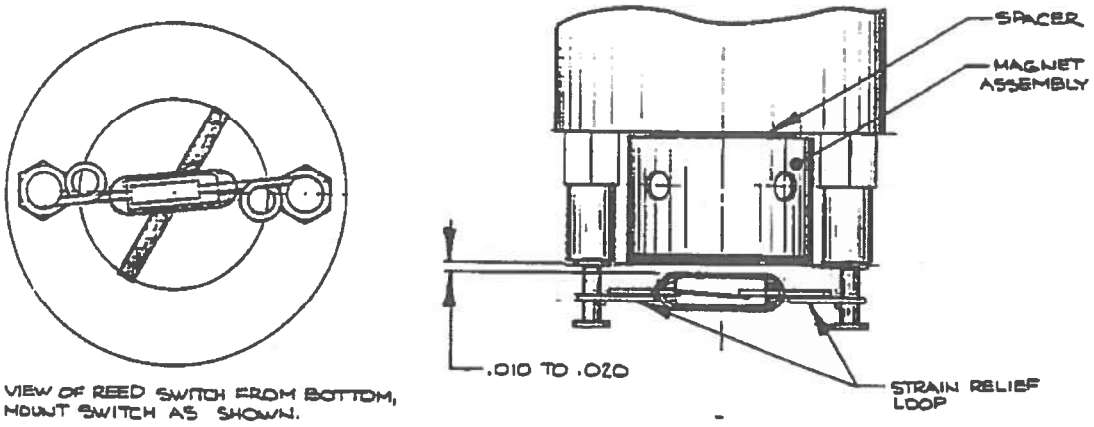
C. Solder the new switch onto the sides on the switch mount terminals, taking care not to stress the point where the leads enter the glass reed switch body. (Solder quickly to reduce excess heat to reed switch.) Measure the distance between the bottom of the rotating magnet and the top of the switch envelope, as shown in Figure 4 -1. The spacing should measure between .010 and .020 inch.

D. Monitor the output of the translator module and spin shaft for an upscale indication. If switch seems to falter, adjust switch slightly closer to magnet.

E. If possible, connect the shaft to an 1800 RPM motor, using a flexible coupling and verify an output of 108 mph with a 50% duty cycle.

F. Reassemble Sensor by reversing procedure.

FIGURE 4-1: REED SWITCH INSTALLATION



4.6 Bearing Replacement Procedures

The bearings used in 014A Sensor are special stainless steel ball bearings with a protective shield. Bearings are lubricated and sealed. Do not lubricate bearings as the lubrication will attract dust and will form an oil/dust glue. Use the following procedure for bearing replacement:

A. Remove bearing mount assembly as per Section 4.4.

B. Loosen set screws(21) in magnet assembly (4), lift shaft (7) and collar (3) up and out of bearing mount (2). Be sure to retain lower spacer (19)

C. Insert a right-angle type of tool, such as an allen wrench into bearing, cock it slightly to one side and remove bearing. Remove both bearings. Clean bearing seats.

D. Install new bearings. Be careful not to introduce dirt particles into bearings. CLEAN HANDS ONLY! DO NOT ADD LUBRICATION OF ANY KIND.

E. Reassemble the Sensor in reverse order. Be sure to include spacers (19) over the bearings when replacing the shaft in the bearing mount. After the magnet assembly (4) has been tightened, a barely perceptible amount of endplay should be felt when the shaft is moved up and down (approximately .004 inch).

4.7 014A Wind Speed Sensor Repair and Recalibration Service

This service provided by the factory enables fast, economical service for the user. This repair and calibration service includes disassembly and detailed electronic components. Service includes replacement of bearings regardless of apparent condition. Service also includes replacement of the following items.

A. Shaft

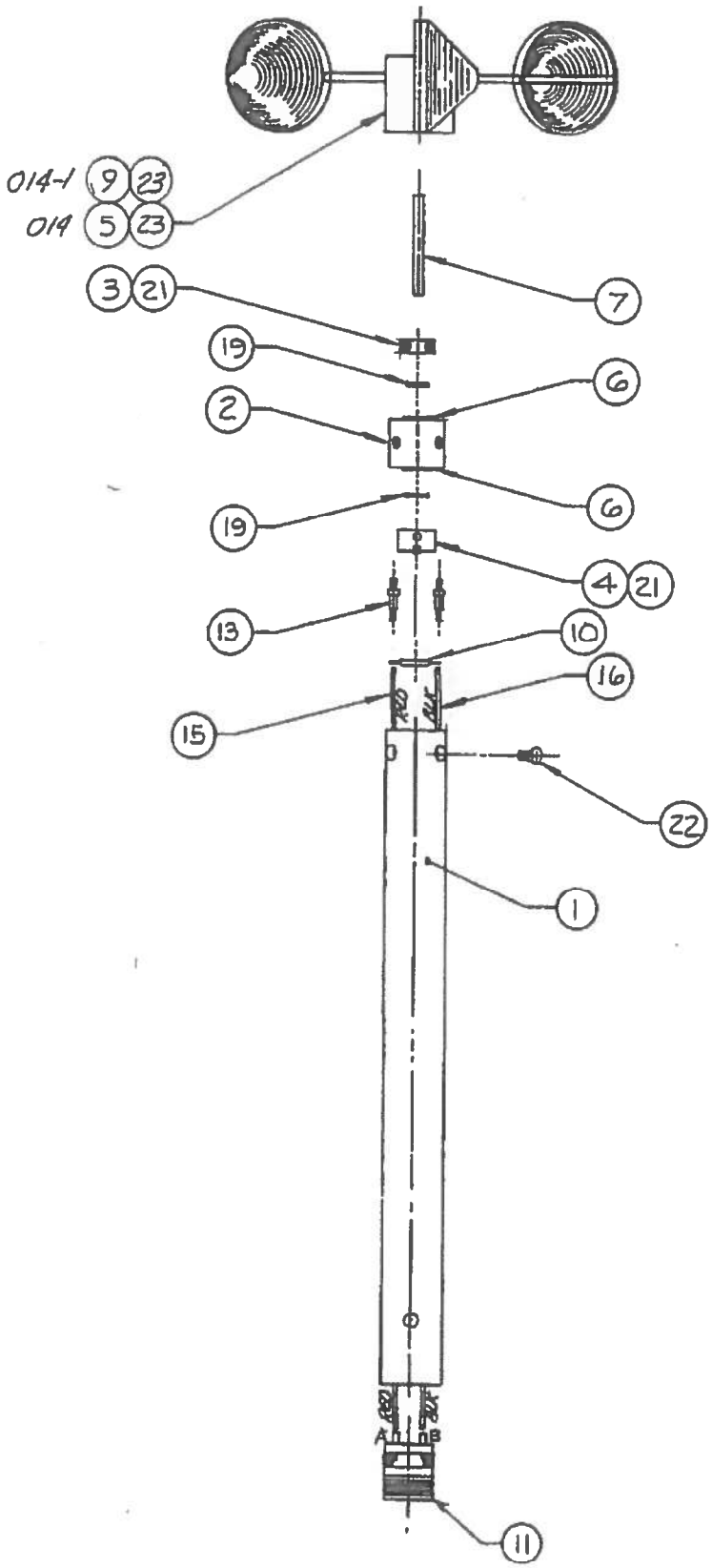
B. All set screws.

Service also includes functional test of Sensor. Other components will be replaced as required. Additional charges for additional materials only will be added to the basic service charge.

Table 4 - 2
REPLACEABLE PARTS LIST

ITEM #	PART #	DESCRIPTION
1	101685-2	WS SUPPORT
2	101685-4	BEARING MOUNT
3 *	101685-7	COLLAR
4 *	101715	MAGNET ASSY
5	101812	CUP ASSEMBLY (ALUM)
6 *	101898	BEARING
7 *	860001	SHAFT
9	101812-1	CUP ASSEMBLY, LEXAN
10 *	2844	SWITCH REED
12	510020	CAP FOR CONNECTOR
13 *	970062	TERMINAL HH SMITH
19 *	860250	SPACER
21 *	601250	SET SCREW 4-40X 1/8
22	601230	FLAT HD. 4-40X 1/4 SCREW

* Parts included in 2402 Rebuild Kit

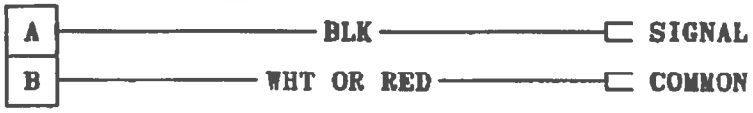


MODEL 014A (-1) EXPLODED VIEW

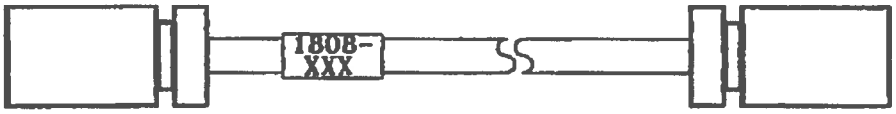
014A-9800 DFV 9/97

1805 SENSOR CABLE - TERMINATES IN SPADE LUGS

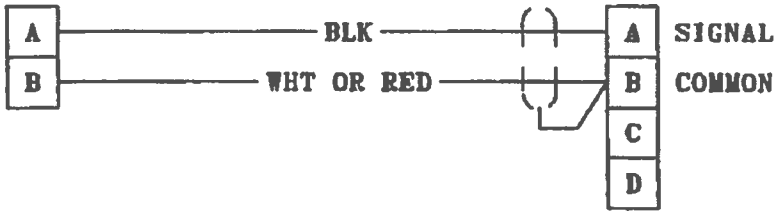
DASH NO. = LENGTH IN FEET



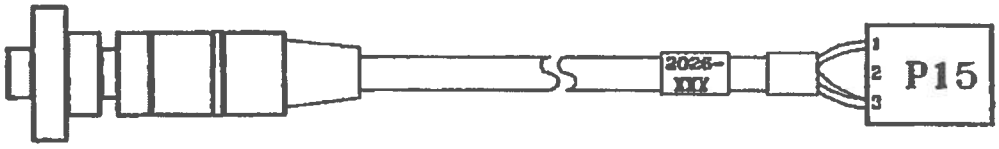
1808 SENSOR CABLE - USE WITH 110 WEATHERPROOF TRANSLATOR

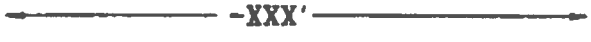


DASH NO. = LENGTH IN FEET

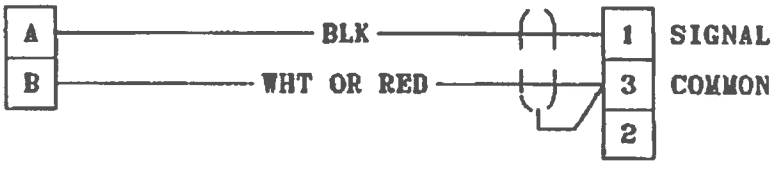


2026 CABLE - USE WITH MET-SET 4B AND 4C





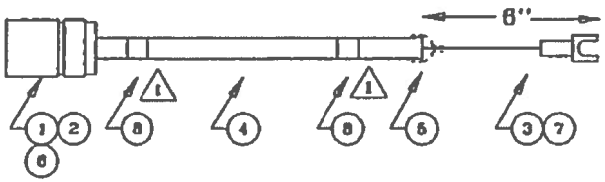
DASH NO. = LENGTH IN FEET



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN PER E.O. 1131	9/11/91	DH

SENSOR END

TRANSLATOR END



SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500372	CONNECTOR, 2 PIN , MS3106A-14S-2S	1
2	450500	CLAMP	1
3	600193	LUG, SPADE, #6	3
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS

ASSY, CABLE, 014 WIND SPEED SENSOR

SIZE	FSCM NO.	DWG NO.	REV
		1805	D
SCALE		SHEET 1 OF 1	

Precipitation Gauges

The accurate measurement of rain and snow precipitation remains one of the most basic elements of meteorology. To enable accurate measurement of precipitation in all environments, Met One Instruments provides a series of instruments incorporating a tipping bucket mechanism. The tipping bucket design allows accurate, repeatable measurements, requires no regular operator maintenance, and is economical and proven in operation.

Features

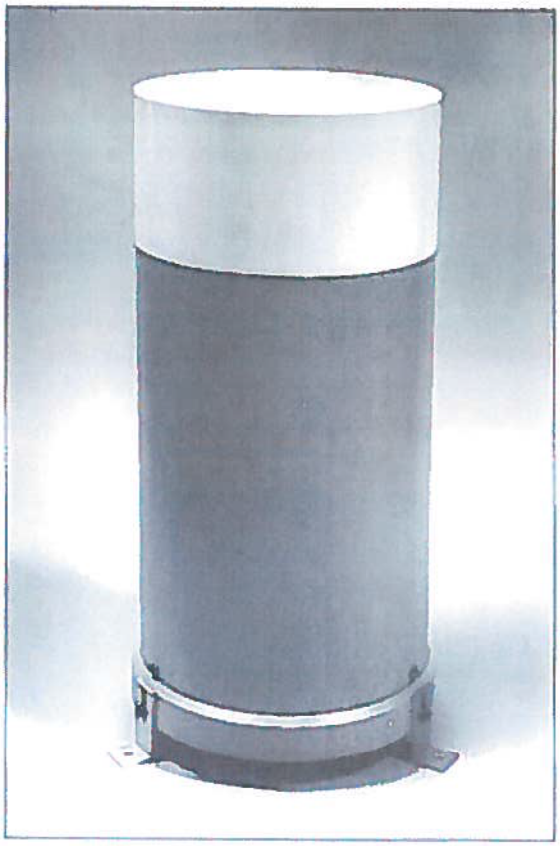
- Jeweled bearings
- Teflon coated bucket
- Reed switch
- Self emptying
- Corrosion resistant materials
- Quality construction

Each model in the series is optimized to meet a particular site and sampling requirement.

Operation

A dual-chambered tipping bucket assembly is located below the collection funnel. When a precise amount of precipitation has been collected in one side of the bucket, gravity tips the assembly and activates a reed switch. A momentary electrical contact closure through the switch is provided for each increment of rainfall. The sample is discharged through the base of the gauge.

For environments that can typically expect a significant amount of frozen precipitation, internal sensor heaters are available. The heating elements are thermostatically controlled to melt and measure the water content of snow and frozen rain, but to avoid evaporative loss.



The Model 370 Raingauge

Construction

The heavy machined aluminum base provides a stable platform for the tipping assembly. The bucket is made from stainless steel and is Teflon coated to prevent retention of the sample. The bucket pivots are precision machined and fitted with jeweled bearings to reduce wear and friction. The funnel is powder coated aluminum and has two screens for preventing leaves and other debris from entering or clogging the gauge. A circular bubble-level and adjustable feet facilitate proper mounting of the unit. Major components are finished in catalyzed polyurethane paint, with a color and texture chosen to allow the sensor to blend into the environment.

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Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Specifications

Rain Gauges

Model No.	Funnel Dia.	Standard Calib.	Optional Calib.
370	8"	0.01"	0.2 mm or 0.25 mm
372	8"	0.5 mm	N/A
380	12"	0.01"	0.2 mm or 0.25 mm
382	12"	0.1 mm	N/A

Rain & Snow Gauges

Model No.	Funnel Dia.	Standard Calib.	Optional Calib.	Heater Voltage
375	8"	0.01"	0.2 mm or 0.25 mm	115 VAC
376	8"	0.01"	0.2 mm or 0.25 mm	220 VAC
377	8"	0.5 mm	N/A	115 VAC
379	8"	0.5 mm	N/A	220 VAC
385	12"	0.01"	0.2 mm or 0.25 mm	115 VAC
386	12"	0.01"	0.2 mm or 0.25 mm	220 VAC
387	12"	0.1 mm	N/A	115 VAC
389	12"	0.1 mm	N/A	220 VAC

Accuracy	at 0.5"/hour	±0.5%	
	at 1" to 3"/hour	±1.0%	
Switch	Type	Reed	
	Rating	10 mA, 28 VDC	
Height	8" Gauges	18" (46 cm)	
	12" Gauges	20.5" (52 cm)	
Weight (not including cabling)		8" Rain Gauges	6 lbs. (2.7 kg)
		12" Rain Gauges	7.5 lbs. (3.4 kg)
		8" Rain & Snow Gauges	6.5 lbs. (3 kg)
		12" Rain & Snow Gauges	11.5 lbs. (5.2 kg)
Shipping Weight (not including cabling)		8" Rain Gauges	8.5 lbs. (3.9 kg)
		12" Rain Gauges	10 lbs. (4.5 kg)
		8" Rain & Snow Gauges	9 lbs. (4 kg)
		12" Rain & Snow Gauges	14 lbs. (6.4 kg
Finish	White Gloss/Biege textured powder coat and clear anodized aluminum		
Cable	Signal	#1566-xx	
	Power (as req'd)	#2517-xx	
		(xx = length in feet)	

Ordering Information

Specify Model number, calibration factor, cable length(s), and accessories.

Accessories and Related Products

Model 820440 Wind Screen. The improved Alter-design screen is constructed of 32 free-swinging, separated leaves. It can greatly improve the accuracy of the precipitation catch by reducing local turbulence.
Model 550500 Evaporation Gauge. This device measures the water level in a standard evaporation pan, and provides an output proportional to that level.

Please contact Met One Instruments for additional information on these products.

Specifications subject to change.

MODEL 375C
8" RAIN GAUGE

OPERATION MANUAL
Document No. 375-9801

Met One
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MODEL 375C
ELECTRIC RAIN/SNOW SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 Model 375C Electric Heated Tipping Bucket Rain/Snow Gauge is an accurate, sensitive and low-maintenance sensor designed to measure rainfall on a continuous basis. Water does not collect in the sensor, but is drained each time an internal bucket fills with 0.01 inch of rainfall (standard calibration). At this time, a switch closure pulse is also sent to the translator module for counting. The sensor is calibrated prior to shipment and requires no adjustments after mounting.

1.2 Sensor Cable is a vinyl-jacketed 2-conductor shielded cable connecting to the sensor via an internal terminal strip. Cable length is designated in -xx feet on each cable part number label.

1.3 Power Cable is a vinyl-jacketed 3-conductor shielded cable connecting to the sensor heaters with wire nuts in an externally mounted J-Box. Cable length is designated in -xx feet on each cable part number label.

Table 1-1
Model 375C Rainfall Sensor Specifications

Orifice	8" Diameter
Calibration (standard) Calibration (options)	.01" Rain per switch closure 0.2mm, 0.25mm
Accuracy	±1% at 1" to 3" per hour at 70° F
Switch Type	Magnet & Reed
Mounting	3 Pads for 1/4 bolts on 9-21/32" (9.66") circle diameter
Dimensions	17-3/4" high, 8" diameter not including mounting pads
Power Requirement	110VAC, 50/60 Hz, 315W
Weight, less cables	7.5 lbs/3.4 kg (10 lbs shipping w/cables)

2.0 INSTALLATION

2.1 Choose a site where the height of any nearby trees or other objects above the sensor is no more than about twice their distance from the sensor. (Sample: 50 ft tree at least 100' away from gauge). A uniform surrounding of objects (such as an orchard) is beneficial as a wind break. Nonuniform surroundings (such as a nearby building) creates turbulence which affects accuracy.

2.2 Mount the sensor level on a platform, using the built in level as an aid. The three legs can be adjusted for leveling. Three 1/4" diameter bolts are used to mount the sensor on a 9-21/32" (9.66") bolt circle.

2.3 Remove shipping restraint (This may be tape, rubber band, or similar item) from sensor bucket and verify that bucket moves freely and that all adjusting screws are tight.

2.4 Connect the signal cable lugs to the terminal strip if not connected already. See diagram. Polarity is not important. See FIGURE 2-1.

2.5 Connect the power cable to the leads inside the condulet (see FIGURE 2-2) if not connected already.

2.6 Replace cover on sensor, tightening screws at base.

NOTE: If snowfall is anticipated, remove primary screen from funnel.

2.7 Route signal cable to the translator or datalogger and connect. Refer to the System Interconnect Diagram in your system manual for terminal identification.

2.8 Route the power cable to a 110VAC power source protected with a 15A GFI circuit. Connect (Ref. FIGURE 2-2). This wiring must conform to local and state wiring codes. If you are not familiar with these codes, an electrical contractor should be used.

Warning:

As with any AC power wiring, improper safety procedures can cause fatal injuries. If you are not qualified to do this work, call an electrical contractor to do it for you.

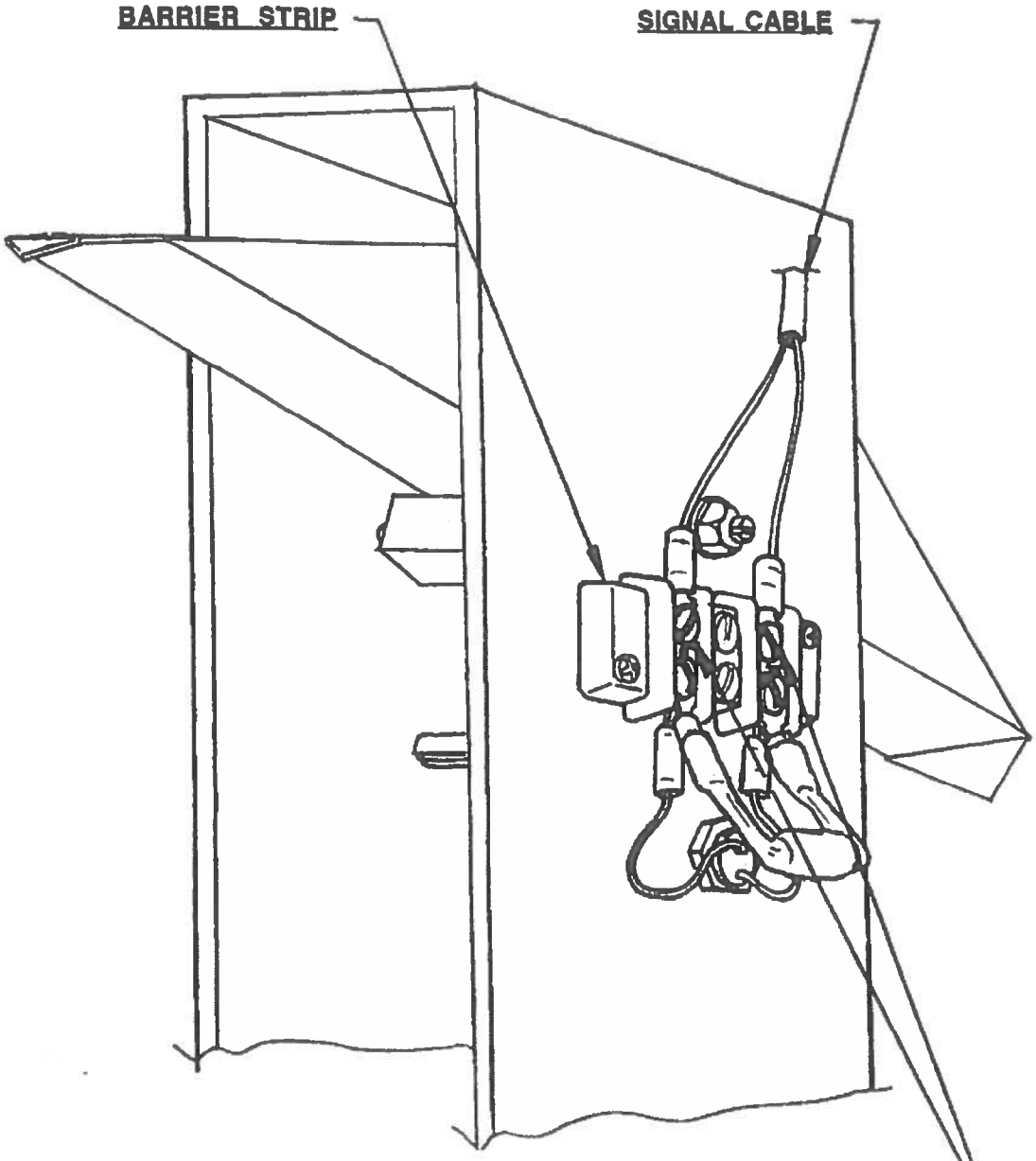
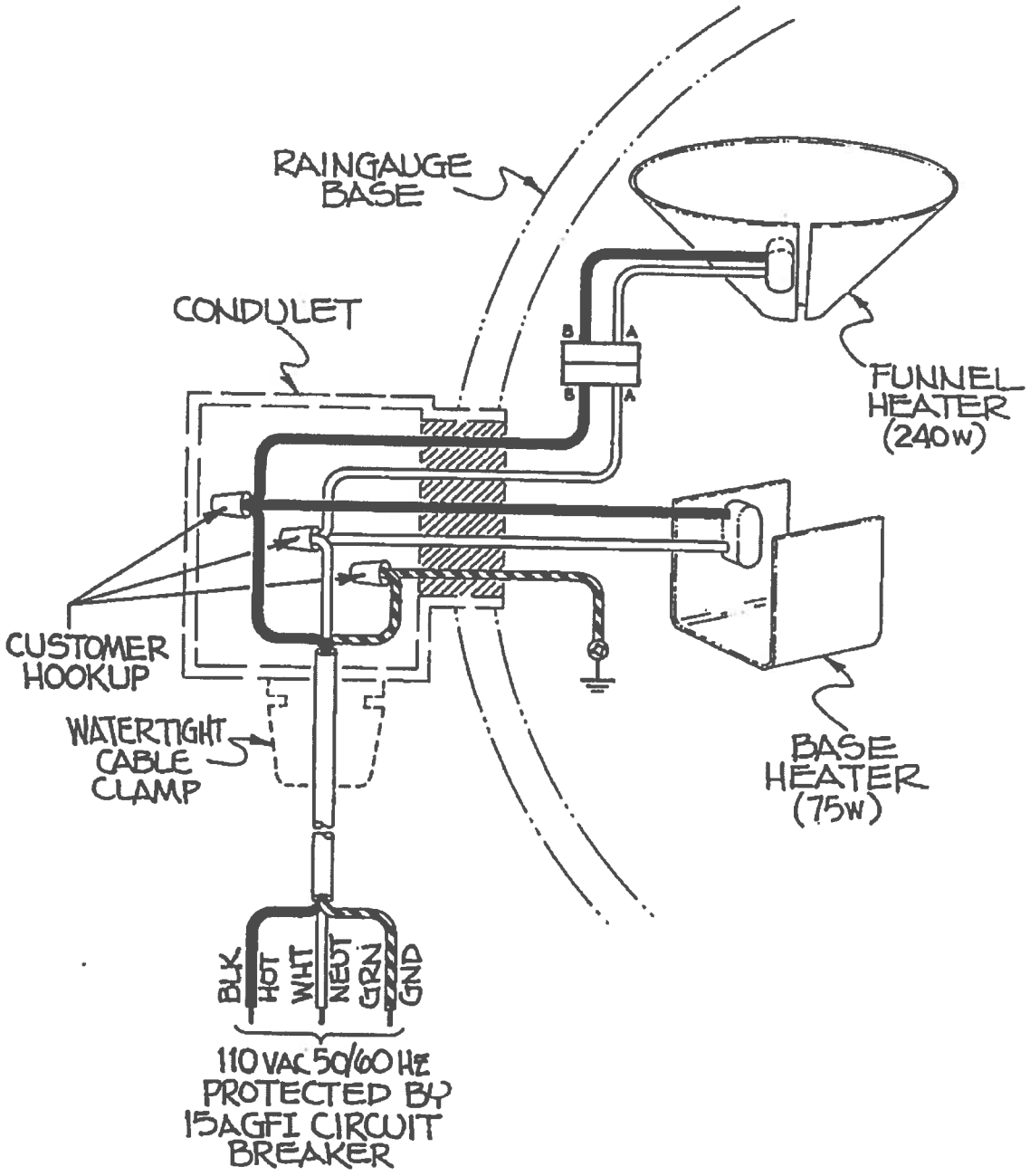

BARRIER STRIP
SIGNAL CABLE
ATTACH SIGNAL CABLE LEADS TO SAME TERMINALS AS REED SWITCH.
(POLARITY NOT IMPORTANT.)

FIGURE 2-1



HEATER POWER HOOKUP

FIG. 2-2

3.0 OPERATIONAL CHECK-OUT

3.1 Manually actuate tip bucket mechanism (stop-to-stop) three (3) times. Confirm that 3 tips have registered on the recording equipment. If not, refer to Troubleshooting Guide, Section 4-3.

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*:
At six month intervals, perform the following steps:

a. Clean sensor funnel and buckets.
b. Do NOT lubricate the pivots, as any lubricant may attract dust and dirt and cause wear of the jewel bearings.
c. Verify that buckets move freely and that translator card or datalogger registers 0.01" or as calibrated for each bucket tip.

*Based on average to adverse environments.

4.2 Calibration. The sensor is factory calibrated; recalibration is not required unless damage has occurred or the adjustment screws have loosened. To check or recalibrate, perform the following steps:

a. Check to be sure the sensor is level.

b. Wet the mechanism and tipping bucket assembly. Using a graduated cylinder, slowly pour the measured quantity of water through the inner funnel to the tipping bucket, which should then tip. Repeat for the alternate bucket. If both buckets tip when filled with the measured quantity of water, the sensor is properly calibrated. If they do not, recalibrate as follows:

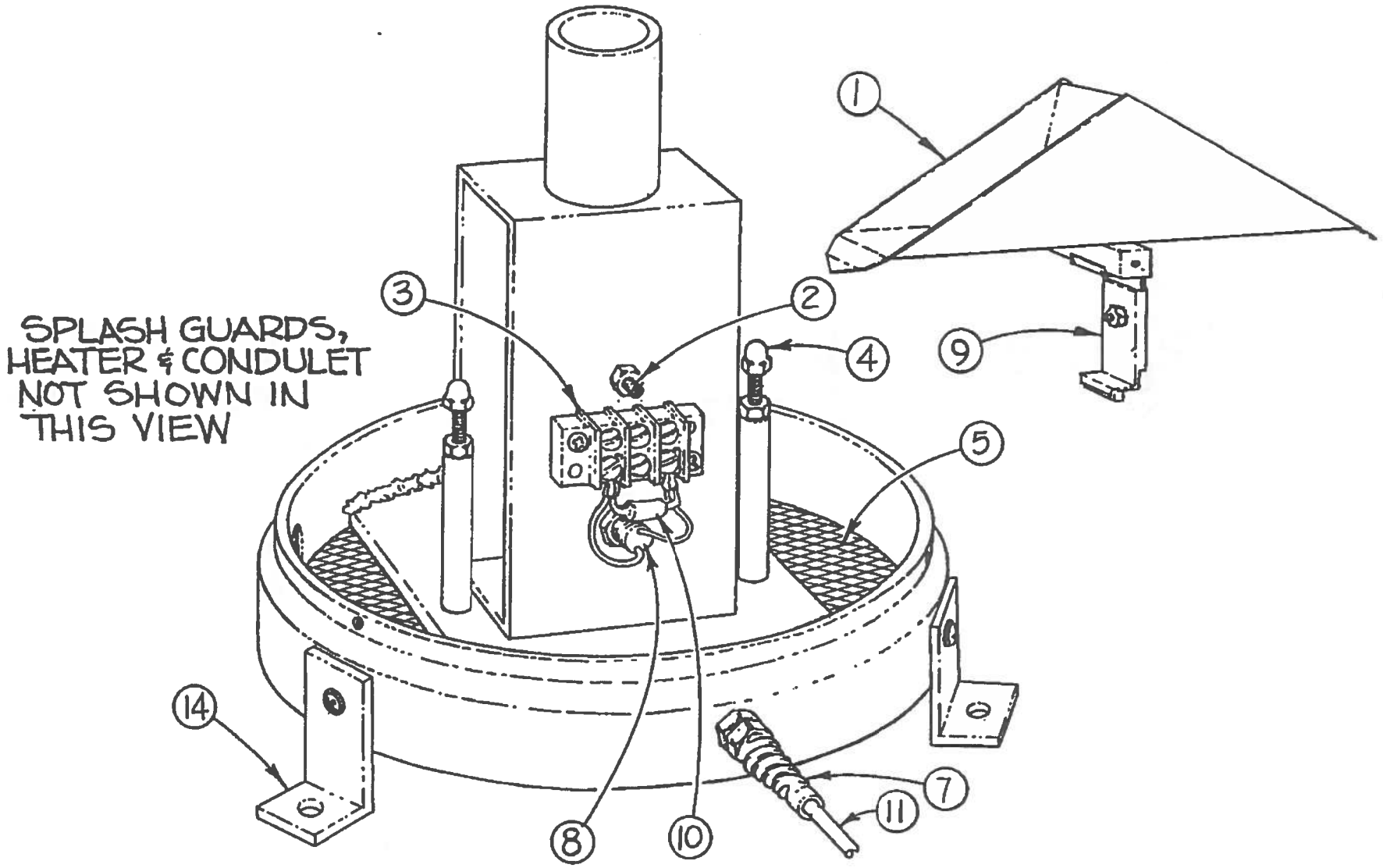
1. Release the lock nuts on the cup adjustments.
2. Move the adjustment screws down to a position that would place the bucket far out of calibration.
3. Allow the measured quantity of water to enter the bucket. (Refer to Table 4.1)
4. Turn the cup adjustment screw up until the bucket assembly tips. Tighten the lock nut.
5. Repeat steps 3 and 4 for the opposite bucket.
6. Measure the quantity of water necessary to tip each bucket several times to ensure proper calibration.
7. Replace the cover on the gauge.

Table 4.1
Calibration Quantities

Tip Calibration	Water Quantity
0.01" (standard)	8.24 milliliters
0.2mm	6.49 milliliters
0.25mm	8.11 milliliters

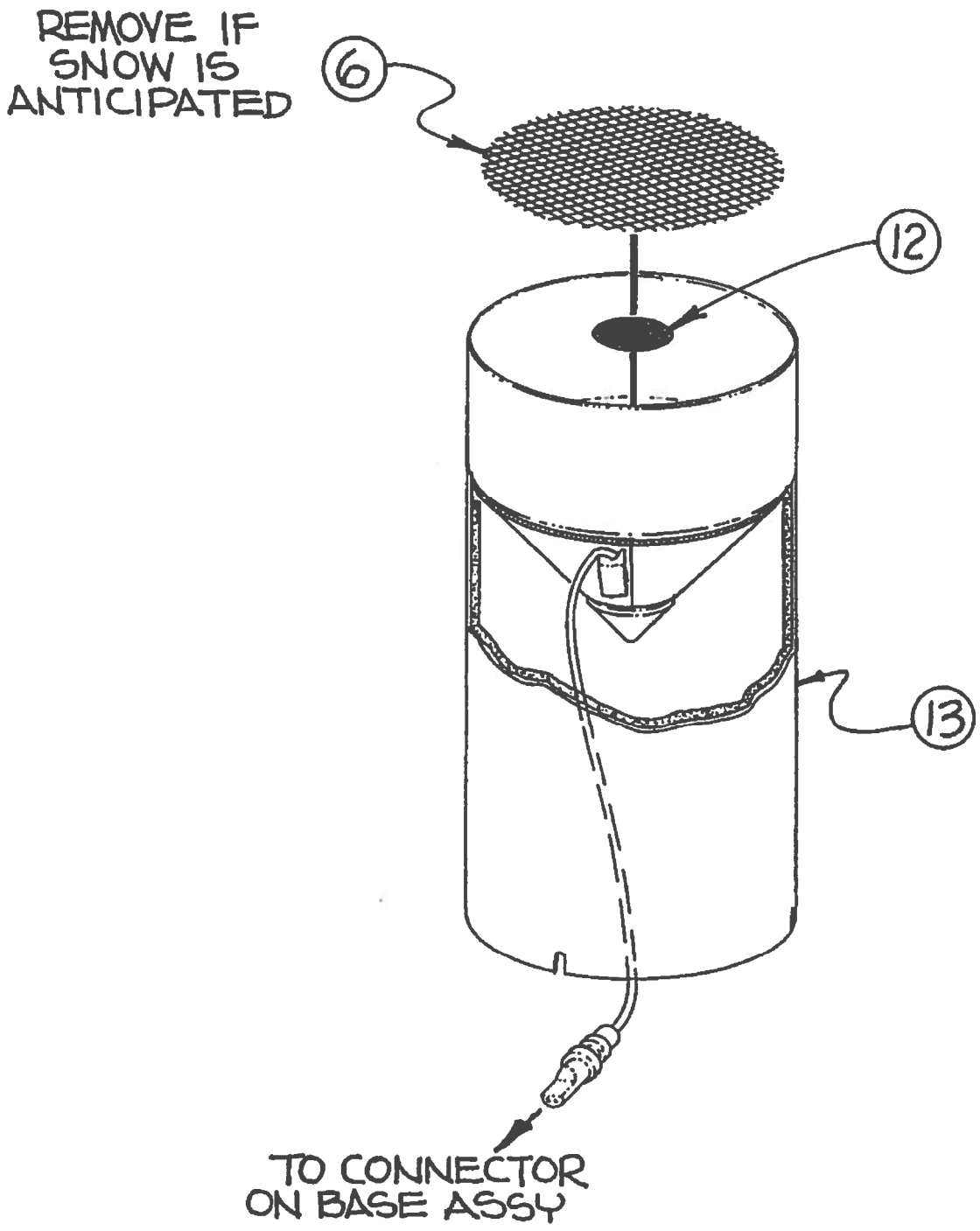
4.3 TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No sensor output	Faulty Reed Switch	Replace Reed Switch
	Signal Cable Connection	Check Connections
	Lightning Strike	Replace Reed Switch & Diode
	Debris in Funnel	Clean (See 4.1)
Erroneous Reading	Sensor not level	Re-level
	Sensor out of Calibration	Recalibrate (see 4.2)
	Site too near trees or other objects	Relocate (See 2.1)
Snow Not Melting	Heaters not getting power	Check circuit protector (customer provided)
	Heater Failure	Return unit to factory for repair.
	Primary Screen Installed	Remove Screen



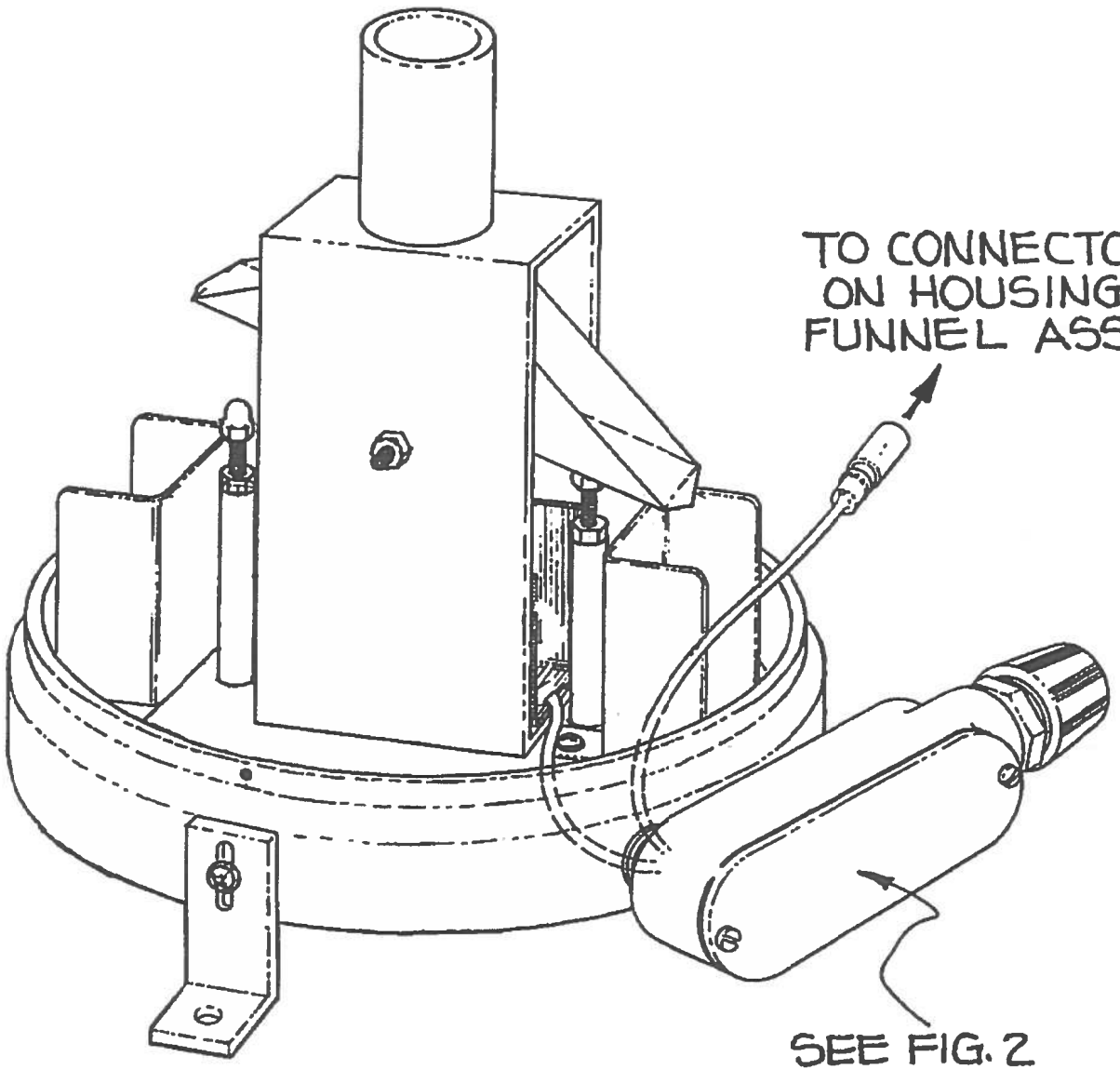
BASE ASSEMBLY

FIGURE 4-1



HOUSING/FUNNEL ASSEMBLY

FIGURE 4-3



BASE ASSEMBLY
(SHOWING HEATER COMPONENTS)

4.4 REPLACEABLE PARTS LIST

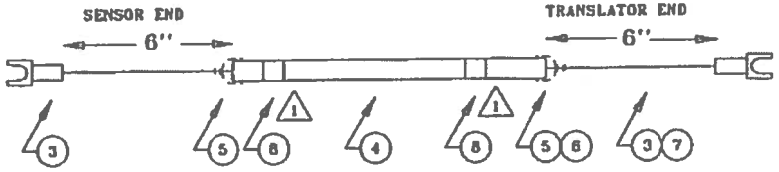
Model 375C Rain Gauge Parts List

I.D. No.	Part No.	Description
1	2545	Assembly, Tip Bucket (.01", .2mm, .25mm)
2	2492	Pin, Pivot
3	340070	Barrier, Strip - 3 pos.
4	480210	Nut, Crown, Nylon #8-32
5	2598	Screen, Base
6	2503	Screen, Primary Top
7	480510	Clamp, Liquid-Tight
8	2934	Reed Switch Cartridge
9	2936	Adjustable Magnet Bracket
10	2937	Lightning Protection Diode
11	1566	Standard Cable Assembly
11	2745	Cable Assembly (for use with Autornet)
12	2504	Screen, Secondary
13	2666	Assembly, Housing/Funnel 8" (115VAC)
14	2516	Foot

4.5 REPAIR AND RECALIBRATION SERVICE

This service provided by Met One Instruments enables fast, economical service for the user. This repair and calibration service includes disassembly, inspection, cleaning, reassembly and calibration. Components will be replaced as required. Additional charges for additional materials only will be added to the basic service charge.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN W/PARTS LIST	9/18/91	DB



1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

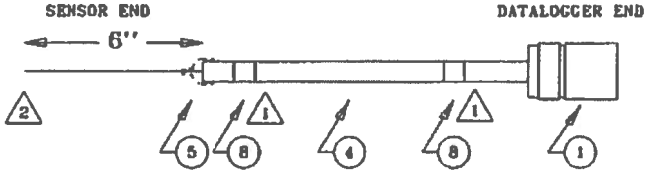
ITEM	PART NO.	DESCRIPTION	QTY
1			
2			
3	600193	LUG, SPADE, #6	5
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6			
7	960510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

MET ONE INSTRUMENTS

ASSY, CABLE, RAIN GAUGE

SIZE	FSCM NO.	DWG NO.	REV
		1566	C
SCALE		SHEET 1 OF 1	

REVISION			
REV	DESCRIPTION	DATE	APPROVED
N/C	PROD REL	8/3/94	DH



ITEM	PART NO.	DESCRIPTION	QTY
1	500102	CONNECTOR, 4 PIN, FEMALE	1
2			
3			
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6			
7			
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET. STANDARD LENGTH = 50 FT
2. STRIP AND TIN WIRE ENDS 1/4"

SOLDER CUP VIEW

MET ONE INSTRUMENTS

ASSY, CABLE, RAIN GAUGE

SIZE	FSCM NO.	DWG NO.	REV
		2745	N/C
SCALE		SHEET 1 OF 1	

Barometric Pressure Sensors

090D
091

Barometric Pressure Sensors convert absolute atmospheric pressure into a linear, proportional voltage, which may be used in any meteorological program.

Features

- Compact size
- Weatherproof enclosure
- Remote output
- Permanent calibration
- Robust construction

These sensors are inherently stable devices that do not require periodic service or routine recalibration.

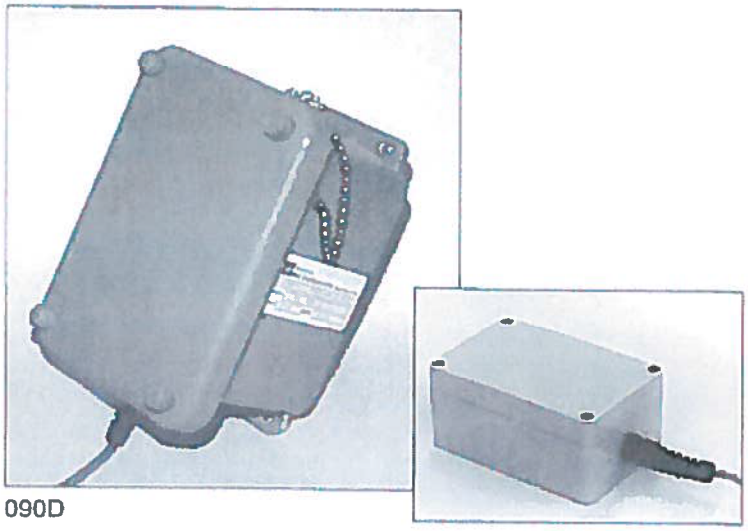
Operation

The enclosure houses a solid-state pressure transducer, with linearization and amplification electronics.

The Model 090D is housed in a heavy duty fiberglass enclosure, suitable for harsh and severe environments. A hose barb is provided to enable the connection of a 1/4" sampling tube to the outside environment.

The Model 091 is contained within a small polycarbonate enclosure, and may be mounted outside or inside a building or other enclosure. Small inlet holes allow the atmospheric pressure access to the sensing element.

The standard range of the 090D/ 091 is 26-32 in. Hg,* suitable for elevations sea level to 1500 ft. Other ranges are available.



090D 091

Specifications

Performance

Resolution	Infinite
Temp Operating Range	-40°C to 65°C
Temp Compensated Range	-18°C to 65°C
Accuracy	±0.04 in Hg (±1.35 mbar) or ±0.125% FS

Electrical Characteristics

Power Requirement	11 mA @ 12 VDC, Typical
Sensor Output	0-1 VDC Standard 0-5 VDC Optional

Physical Characteristics

Weight, 090D	2 lbs 5 oz (1.05 Kg)
Dimensions, 090D	5.5" x 5" x 7.5" (14x12x19 cm)
Weight, 091	8.8 oz. (250 g)
Dimensions, 091 cm)	2.13" x 3.2" x 5" (5.4x8.3x13

Ordering Information

	Specify elevation Specify output voltage
Cable	#1169-xx (xx = length in feet) Specify length in feet

Specifications subject to change without notice.
*Conversions: 1 in. Hg = 3.3864 kPa, 1 in. Hg = 33.864 mbar, 1 in. Hg = 25.4 mm/Hg

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MODEL 091
BAROMETRIC PRESSURE SENSOR

OPERATION MANUAL
Document No. 091-9800

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Barometric Pressure Sensor Model 091
Operation Manual

1.0 GENERAL INFORMATION

1.1 091 Barometric Pressure Sensor uses an active solid-state device to sense barometric pressure. Self-contained electronics provide a regulated voltage to the solid state sensor and amplification for the signal output.

1.2 A 1169-XX' Sensor Cable is a 4-conductor shielded, vinyl jacketed cable. Length is given in -XX feet on each cable part number label.

TABLE 1-1

Model 091 Pressure Sensor Specifications

Performance

Calibrated Range	26-32" (standard)*
Calibrated Operating Range	-18°C to +50°C
Operating temperature range	-40°C to +50°C
Resolution	Infinite
Accuracy	±0.04 in Hg (±1.35 mb) or
Accuracy	±0.125% FS
Output	0-1V DC (standard)*

*Refer to model number of sensor. Example: 091 - 26/32 - 1

Basic Mod # Range ("Hg) Output Voltage

(In this example, the sensor output is 0-1v for a range of 26 to 32" Hg)

Electrical Characteristics

Power Requirement	11 ma @ 12 VDC
Sensor Output	0-1 VDC Standard
	0-5 VDC Optional

Physical Characteristics

Weight	8.8 oz (250 g)
Dimensions	2.13" x 3.2" x 5" (5.4x8.3x13 cm)

2.0 INSTALLATION

2.1 Mounting the Sensor. Mount sensor in a convenient location with pressure inlet port facing downward.

2.2 Installing the Cable. The 1169 Cable Assembly contains four wires. Install the cable into the water-tight gland and connect cable as follows:

SIG = Signal Output (Wht)
COM = Signal Common (Grn)
+12 = +12V Power (Red)
COM = Power Com (Blk)

3.0 OPERATION

3.1 The Barometric Pressure Sensor has been calibrated at the factory, and will not change unless it is damaged. To check for proper operation of the sensor and module, it is advised that the module's output be checked against a local weather service facility. Exact correlation is not to be expected, due to geographical and meteorological variations. The sensor reads absolute barometric pressure, whereas local weather services readings are normalized to sea level values.

3.2 One should keep in mind that nominal pressure, at sea level, is 30 inches of mercury and that for every 1,000 feet of elevation, the pressure decreases approximately one inch of mercury. EXAMPLE: A weather station at sea level may use a barometer with a range of 26 to 32 inches of mercury to cover all possible weather conditions. However, a weather station, located 4,000 above sea level, would require a range of 22 to 28 inches of mercury.

MODEL 091 BAROMETRIC PRESSURE SENSOR
RANGE SELECTION GUIDE

ELEVATION	RANGE ("Hg)
0 to 1,500	26/32
1,501 to 3,500	24/30
3,501 to 5,500	22/28
5,501 to 8,000	20/26
8,001 to 10,000	18/24
10,001 to 12,500	16/22
12,501 to 15,500	14/20
15,501 to 19,000	12/18

3.3 Each sensor is provided with a calibration data sheet showing transducer outputs at two or more pressure levels. It is important to record these values, as they are required, should it ever be necessary to recalibrate the pressure translator module in the field. If these values are lost, the sensor can be returned to the factory for recalibration.

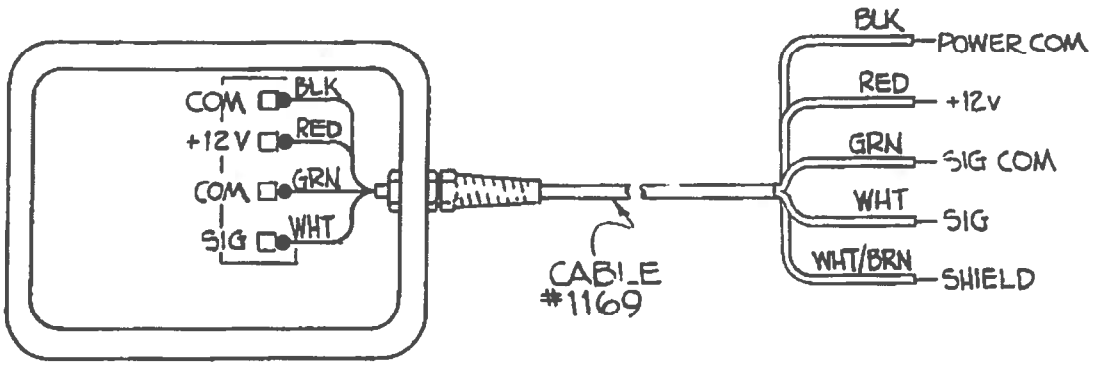
4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule.

A. Inspect pressure inlet port occasionally to insure it is free of obstruction. No other periodic maintenance or calibration is required.

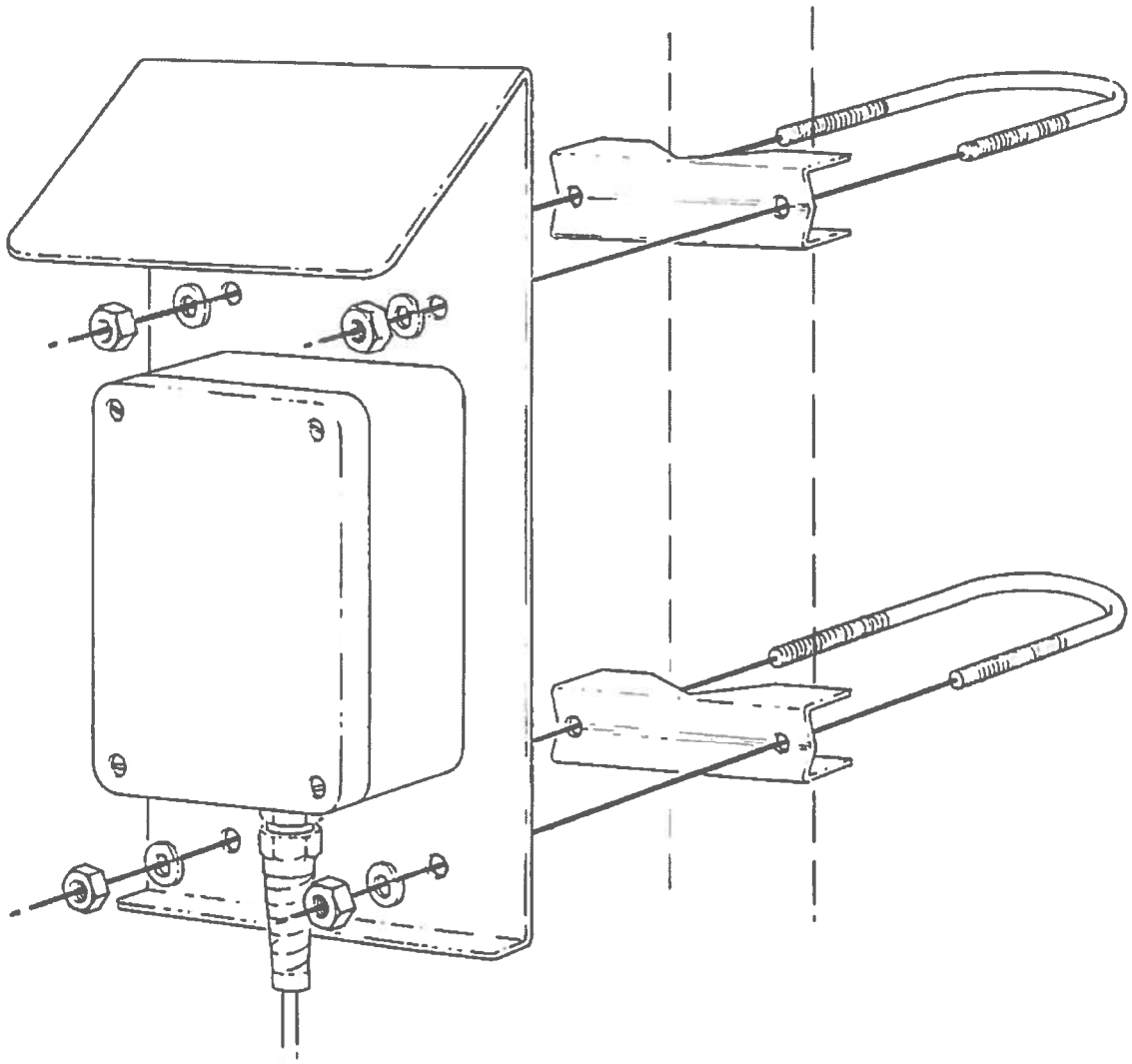
B. Inspect sensor for proper operation per Section 3.1.

4.2 091 Pressure Sensor Maintenance. The pressure sensor is an inherently stable device that does not require periodic service or recalibration. Should service or recalibration become necessary, the sensor must be returned to the factory. Always inspect Model 091 Pressure Sensor to make sure that inlet port is clean and free from obstructions.

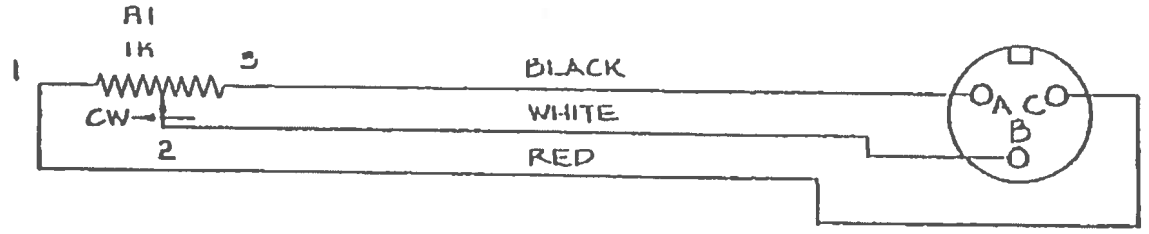


MODEL 091 BAROMETRIC PRESSURE SENSOR
CABLE CONNECTIONS

(See Section 2.2)



MODEL 091 MOUNTING DETAIL

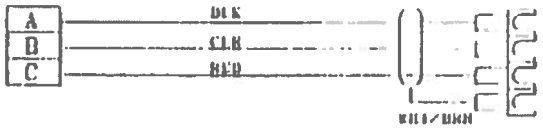


3 PIN MALE MINI BULK-HEAD CONNECTOR
*MS-3102A-10SL-3P

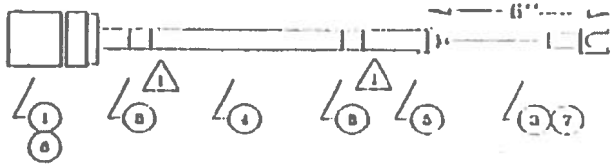
NOTE:
CLOCKWISE DIRECTION INDICATED IS FOR GEAR BOX MOUNTED POTENTIOMETER

INTERNAL WIRING DIAGRAM

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD REL - REDRAWN	12/2/93	DH



SENSOR END TRANSLATOR END



ITEM	PART NO.	DESCRIPTION	QTY
1	SEE NOTE	CONNECTOR, 3 PIN, MS	
2			
3	800103	LUG, SPADE, #6	4
4	400011	CABLE, 3 COND, W/SHIELD	A/R
5	000050	SLEEVING, 1/4", SHRINK	A/R
6	060075	SLEEVING, 1/8", SHRINK	A/R
7	000510	WIRE, 22 AWG, WHT/BRN	6"
8	060060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

NOTE: CONNECTOR SUPPLIED WITH EVAP GAUGE 550502

1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS

ASSY, CABLE, EVAPORATION GAUGE

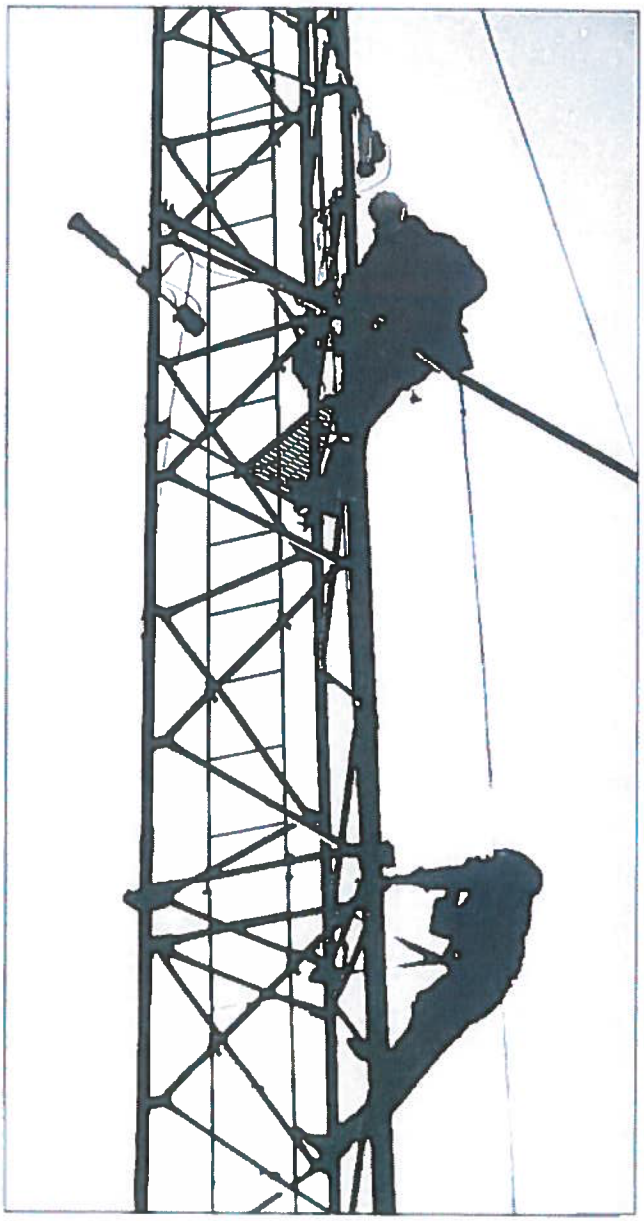
SIZE	FSCM NO	DWG NO	REV
		5883	A
SCALE		SHEET 1 OF 1	

Towers and Tripods

All meteorological systems need a means of raising the sensors to the required elevation above ground level. The standard reference point is ten meters, or approximately 33 feet; however, measurements are frequently required at any elevation from a few feet to several hundred feet. Met One Instruments meets this need with a full line of towers, tripods, and instrument lift systems.

Standard Stacked Towers

Standard stacked towers are built on a 12" equilateral triangle of 1" steel tubing with electrically welded, continuous steel "zig-zag" cross bracing. This design results in a structure that is at least one-third stronger than competing towers. All sections are hot-dipped galvanized after fabrication for corrosion protection. Individual 10-foot sections are light weight (31 pounds), and are easily connected to each other using double-bolted leg joints. Most installations use guying cables to anchors located at a distance of 80% of the tower height. However, the structure is strong enough to be self-supporting using a house bracket. Several base configurations are available, incorporating a concrete foundation.



Model 970664 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A pier pin is provided which must be located within the foundation. The base of the tower fits over the projecting pin to locate the tower and prevent the base from moving off the foundation. Complete guying materials are provided, including a bracket assembly for the tower, guy cables, turnbuckles, clamps, thimbles, etc. Three anchor rods for guy points are provided, each of which requires a poured concrete foundation. Grounding rods are provided for the tower and each guy point.

Model 970668 40' guyed tower

This tower is identical to Model 970664, except that screw-in anchors are provided for the guy points in place of the poured foundation style.

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Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Model 970666 30' guyed fold-over tower

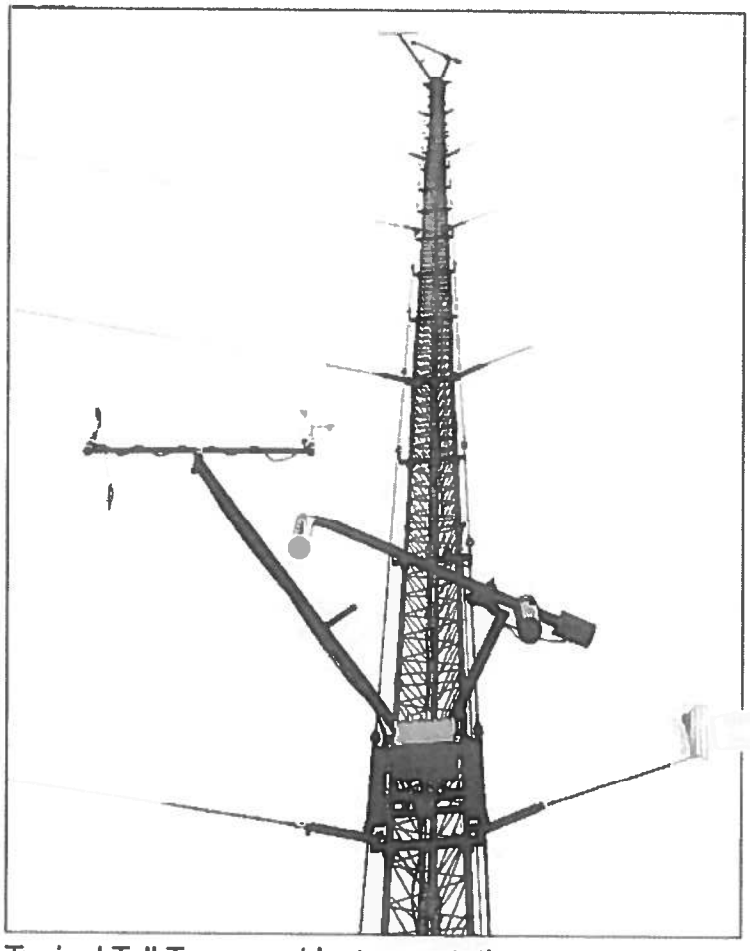
This tower hinges at approximately 10 feet above ground level, allowing the instrumentation mounted on the tower to be serviced from ground level. One special foldover section, one standard 10 foot section, and a tapered top section are provided. A winch mechanism and cabling are included to activate the tilt mechanism. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Four screw anchors to provide guy points to the hinge level are included. Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970667 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Three screw anchors to provide guy points are included Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970665 40' bracketed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Brackets are provided to support the tower to an adjacent building, eliminating the need for guy cables and anchors. Grounding rod is provided for the tower.



Typical Tall Tower and Instrumentation

Aluminum Towers

Aluminum alloy towers have the advantage of lightness of weight which makes relocation from site to site easier. They are also often used in mobile operations, such as on van or trailer mounted monitoring stations.

Model 970894 33 Foot aluminum tower, guys suggested but not required

Tapered top section with 11" leg width, straight center section, 11" width, Lower section with 14" leg width (reducing to 11"). Height to make 10 meters is provided by mast extension. Steel base suitable for imbedding included. Guy kit will be provided to suit requirements.

Model 305831 35 foot telescoping aluminum tower

A light weight tower composed of 3 nested aluminum sections. An integrated winch is used to raise and lower the sections. Guy wires, turnbuckles, cable clamps, etc. are furnished to guy each section, and duckbill ground anchors are provided. The tower is crated for shipment. An optional power w[illegible] is available in either 110 VAC or 12 vdc.

Tower Options

#5284 Tower grounding system

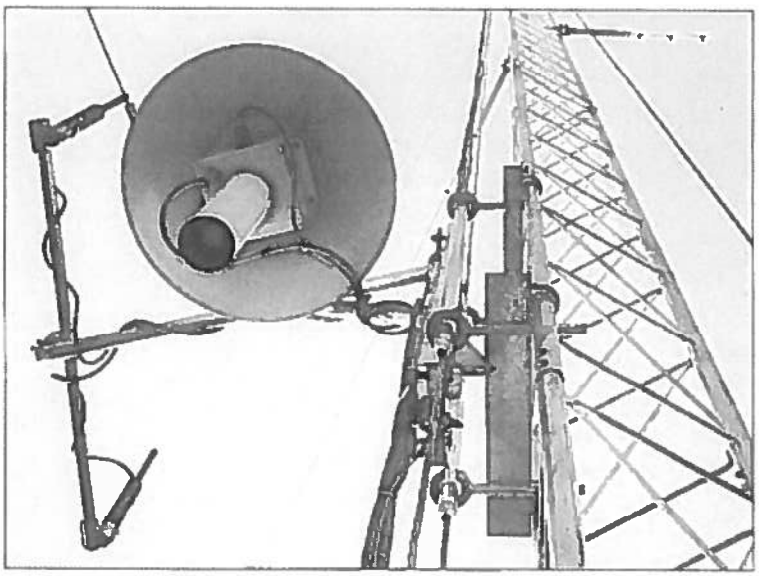
The Model 5284 includes all materials required to provide lightning protection to the tower. An air terminal with 5' extension rod, braided 2-0 copper cable, ground rod, and all clamps are provided.

#2420 Instrument boom

The Model 2420 includes two special cross fittings and a five-foot long, 3/4" IPS aluminum boom. The Model 2420 allows the boom to mount to the side of any tower having a leg diameter of 1.25 inches (standard stacked towers). Aluminum construction for corrosion resistance.

Model 191 Crossarm Assembly

The primary mounting device for meteorological sensors. Includes cross fitting to mount to vertical or horizontal 3/4" IPS pipe, such as the #2420 Instrument boom.



Instrument Lift Carriage

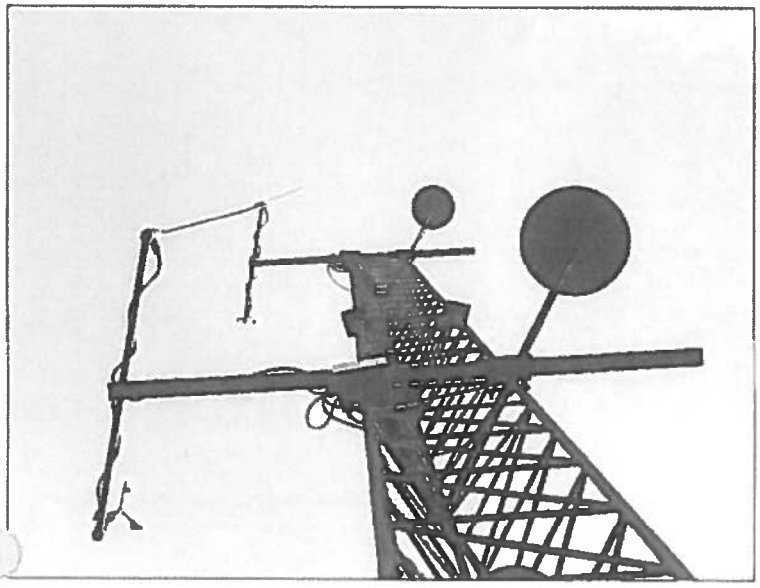
Model 173/175 Instrument Lifts

To avoid the difficulty and danger of tower climbing, the instrument lift is used to return sensors to ground level. Service to the system is easily accomplished without the expense and delay of contracting a professional climber.

Major structural members are hot-dipped galvanized steel. A three-foot instrument boom is standard with all instrument lift systems.

The Model 173 provides a continuous loop drive cable to positively raise and lower an instrument carriage to a maximum height of 100 feet (30 meters). A powered drive winch is an available option.

The Model 175 is a light duty system utilizing a hand-crank winch. The maximum recommended height for this system is 50 feet (15 meters).



Boom and Crossarm Assemblies

Tripod Towers

Tripod towers provide an economical, quick, and easy solution for sensor mounting. We offer a variety of tripods to meet virtually any meteorological system requirement.

Model 2150/2151 Tripods

Lightweight and sturdy, these tripods are constructed of galvanized steel tubing, and come fully assembled. Installation is accomplished by simply opening the legs and installing the mast. Each leg is furnished with a swiveling foot, enabling the tripod to be installed either on a flat surface or a pitched roof. A complete guying kit, including ground stakes, is included. The1-1/4" OD aluminum mast includes a reducer to allow use of an optional Model 191 Crossarm assembly.

Specifications

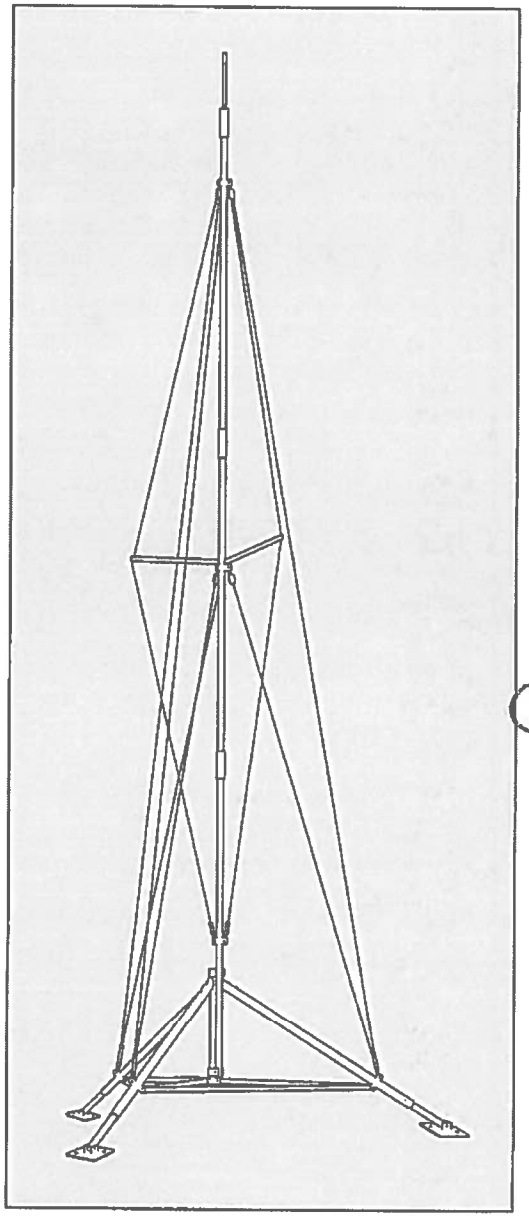
Model	Height to top of mast	Weight (approx.)
2150	11 Ft.	13 lbs.
2151	14 Ft.	18 lbs.

Model 6168/6230 Tripods

"Heavy-duty, self-supporting and extremely robust" describe these tripod towers. The unique design features self-contained guying and a wide footprint to provide strength and stability even in winds as high as 100 mph. Constructed of heavy aluminum tubing, the design features a fold-over mast to ease installation and facilitate servicing of the installed equipment. Heavy galvanized steel "feet and ankles" contribute to stability and are adjustable to conform to terrain variations. The feet can be staked to the ground for added stability. The strength, stability, and economy of these tripods make them a viable alternative to traditional instrument towers.

Specifications

Model	Height to top of mast	Weight (approx.)
6168	20 Ft. (6 M)	170#
6230	33 Ft. (10 M)	205#



Model 6230

Tower Erection and Turnkey Systems

Frequently the customer will find it expeditious and economical for a single contractor to have complete site and system responsibility. Unfortunately it is not easy to find a company that knows both sensors *and* pouring concrete. Met One Instruments has this knowledge—and the experience—gained from supplying numerous turnkey systems throughout the country and overseas. Met One Instruments' project engineers are conversant in all phases of construction associated with meteorological sites. Consult our sales department for budgetary estimates or firm quotations.

MODEL 5284
TOWER GROUNDING SYSTEM

OPERATION MANUAL
DOCUMENT 5284-9800

Met One
Instruments

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Telephone 541-471-7111
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5284 Tower Lightning Rod
And Grounding System

Introduction

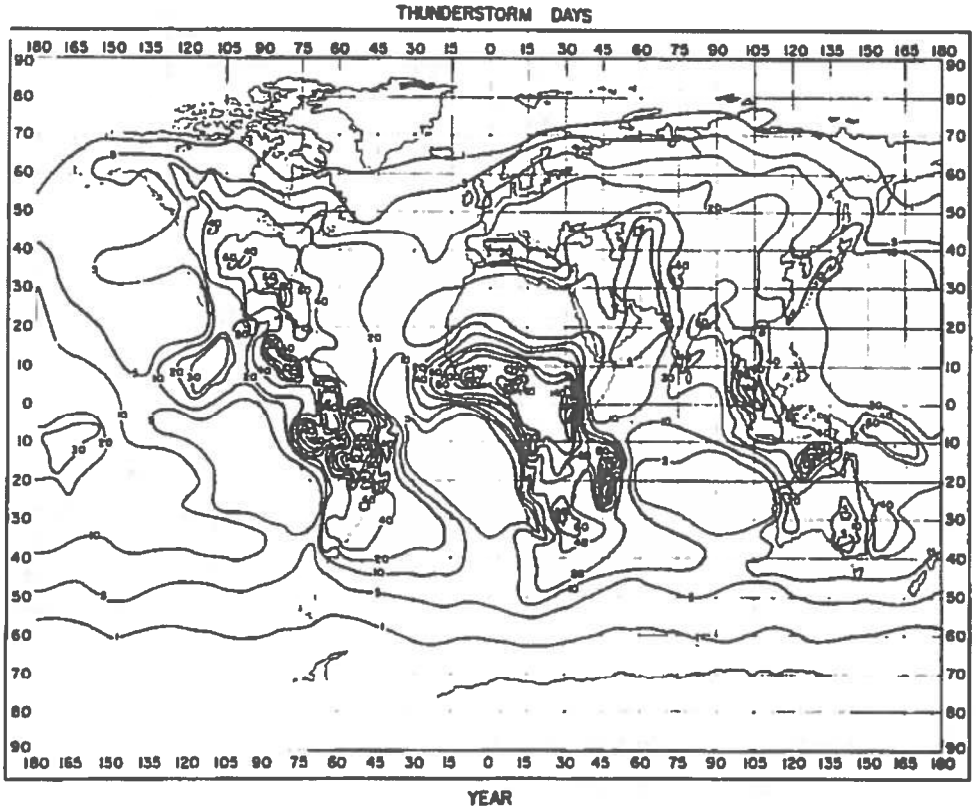
High voltage electrical surges caused by lightning are a common source of failure of both sensors and associated electronics. In addition to the protection devices built in to our sensors, Met One provides has provided a tower ground system. The grounding system and lightning rod will increase the likelihood that the system will survive a lightning strike. However a direct strike, no matter how well protected, will likely result in component or system failure.

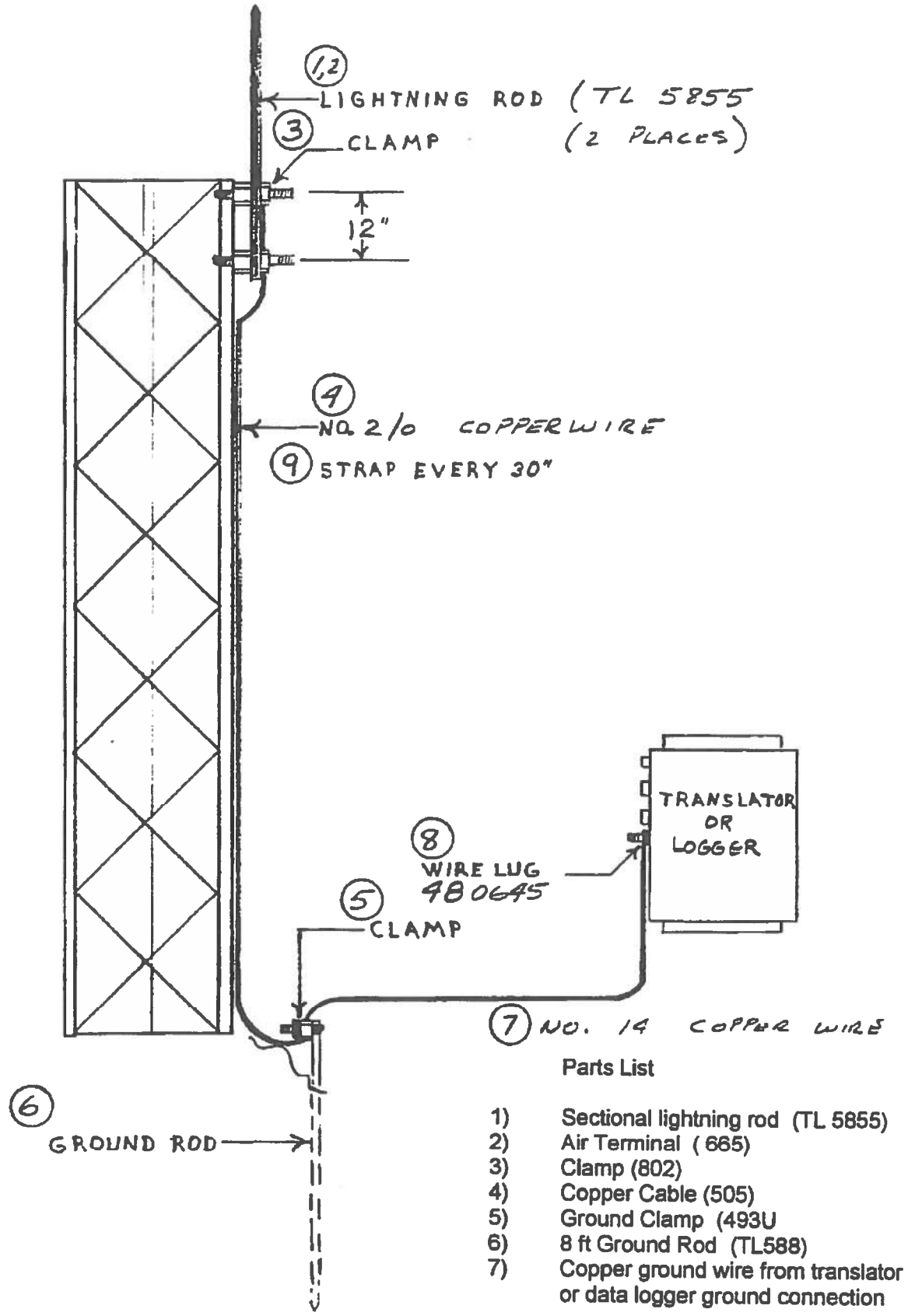
The part number 5284 Tower Lightning Rod And Grounding System provides an air terminal at the top of the tower, that is connected to earth ground using a heavy gauge copper wire. It provides a direct path to ground from electrical energy caused by a strike or by the EMF of a nearby strike. The system provides a 60 degree cone of protection from the apex of the air terminal to the ground.

Installation

Installation of the various components is very easy. The basic idea is to have the vertical air terminal at the top of the tower mounted using the two clamps and cable provided. At the base of the tower a ground rod is driven into the ground and the opposite end of the cable is attached to this point. If a base grounding kit was provided with the tower, add the additional ground rod to the base grounding kit to improve the ground resistance. See Figures 1 and 2 for basic details of the installation.

If the tower base grounding kit was supplied with the tower, be sure that the heavy gauge braided copper wire is used for attachment to the ground rod. The small #4 cables should be used for the connection from the tower legs to the other ground rods. For maximum effectiveness of the grounding system, the ground resistance to the rod should be less than 10 ohms.





Parts List

1) Sectional lightning rod (TL 5855)
2) Air Terminal (665)
3) Clamp (802)
4) Copper Cable (505)
5) Ground Clamp (493U
6) 8 ft Ground Rod (TL588)
7) Copper ground wire from translator or data logger ground connection

FIGURE #1 Tower Lightning Rod and Grounding System

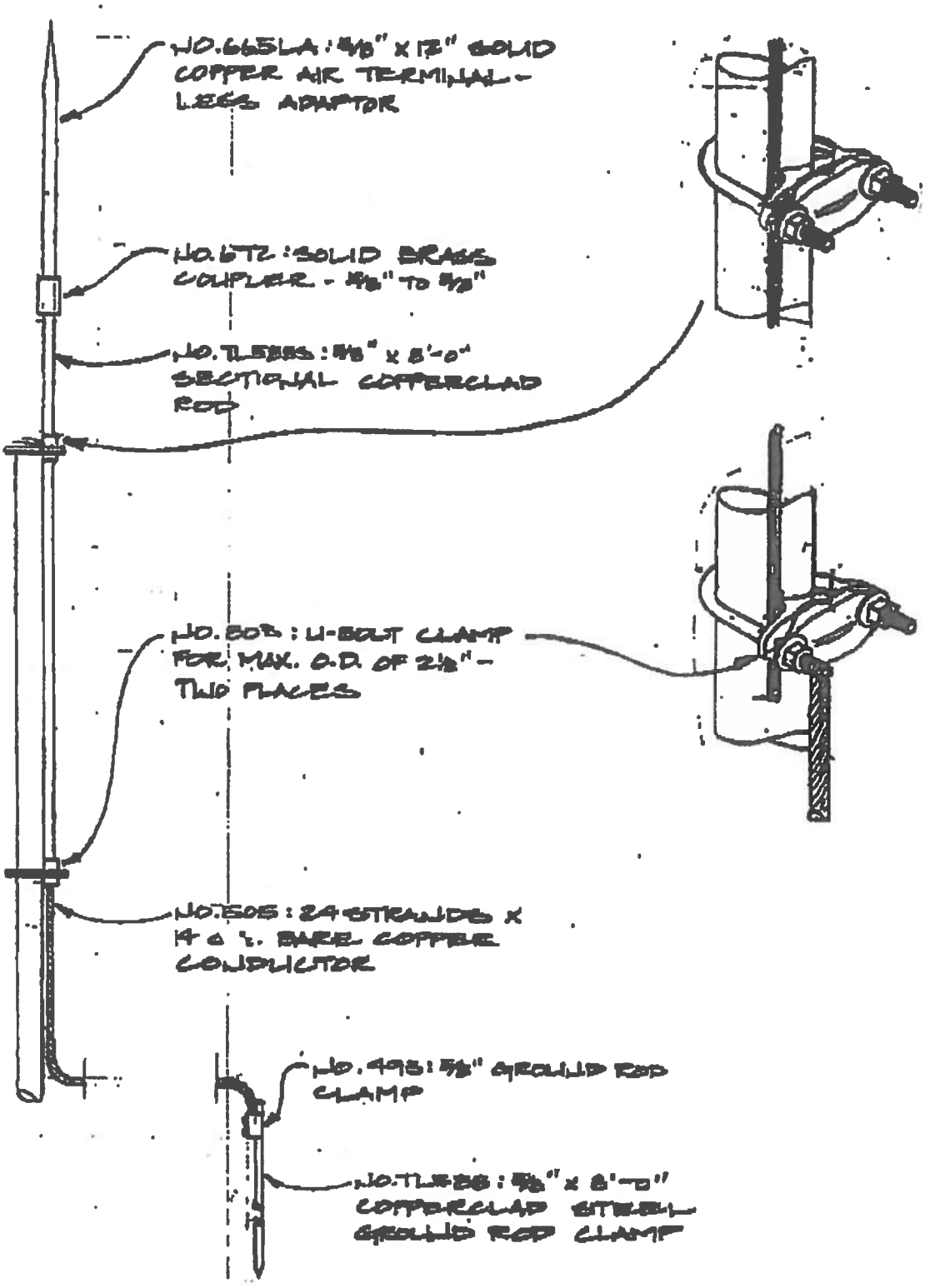
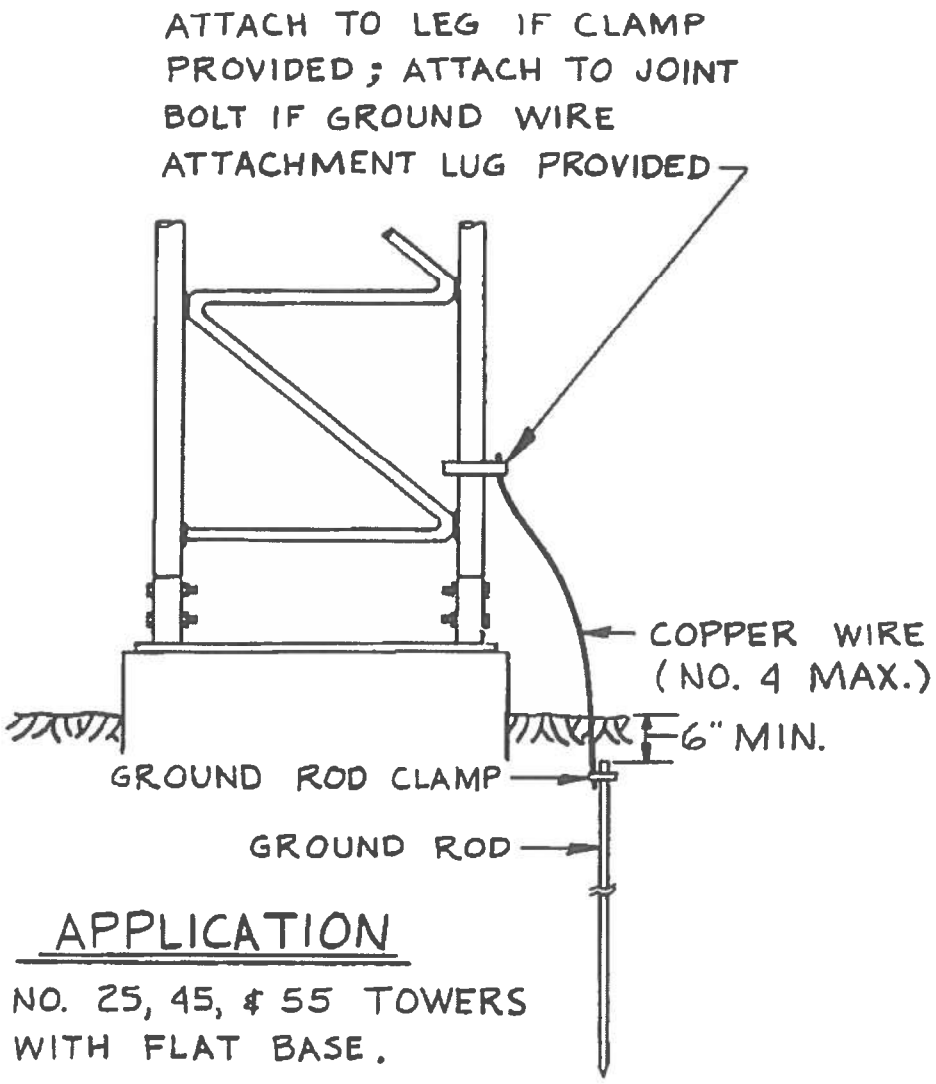


Figure #2 Clamping to lightning rod installation detail



BASE GROUNDING KITS

Figure #3 Tower Base Grounding Kit Detail

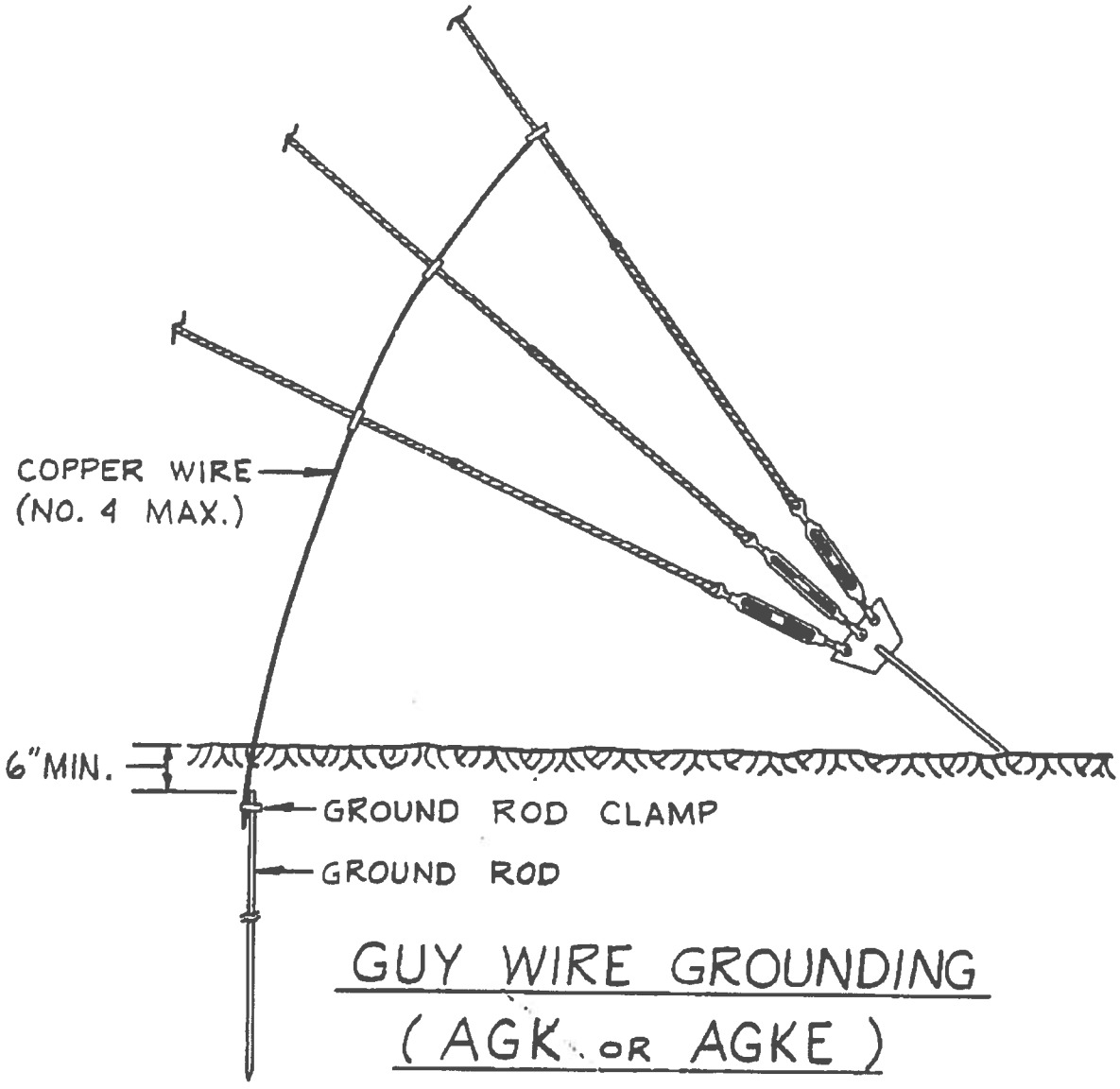
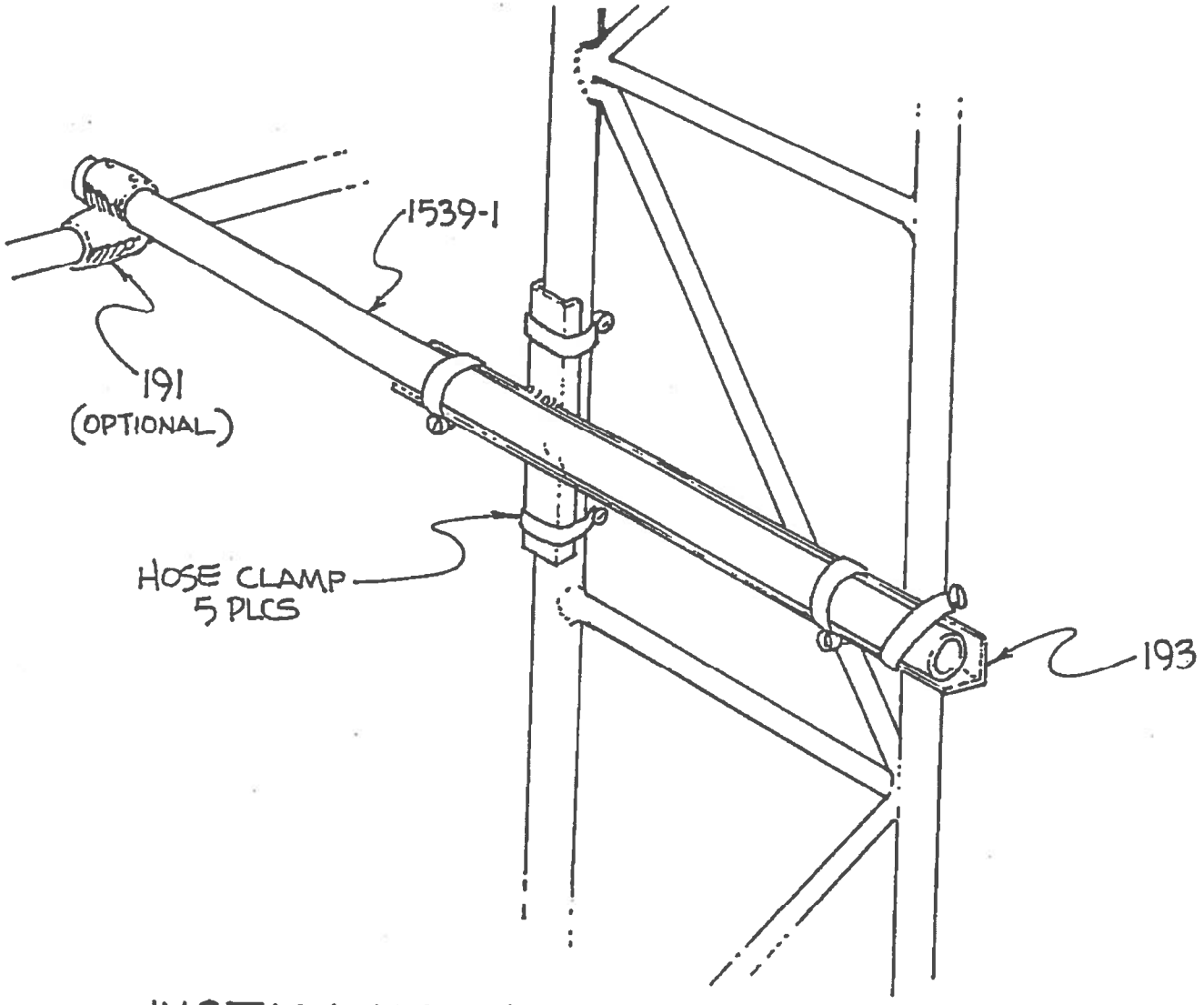


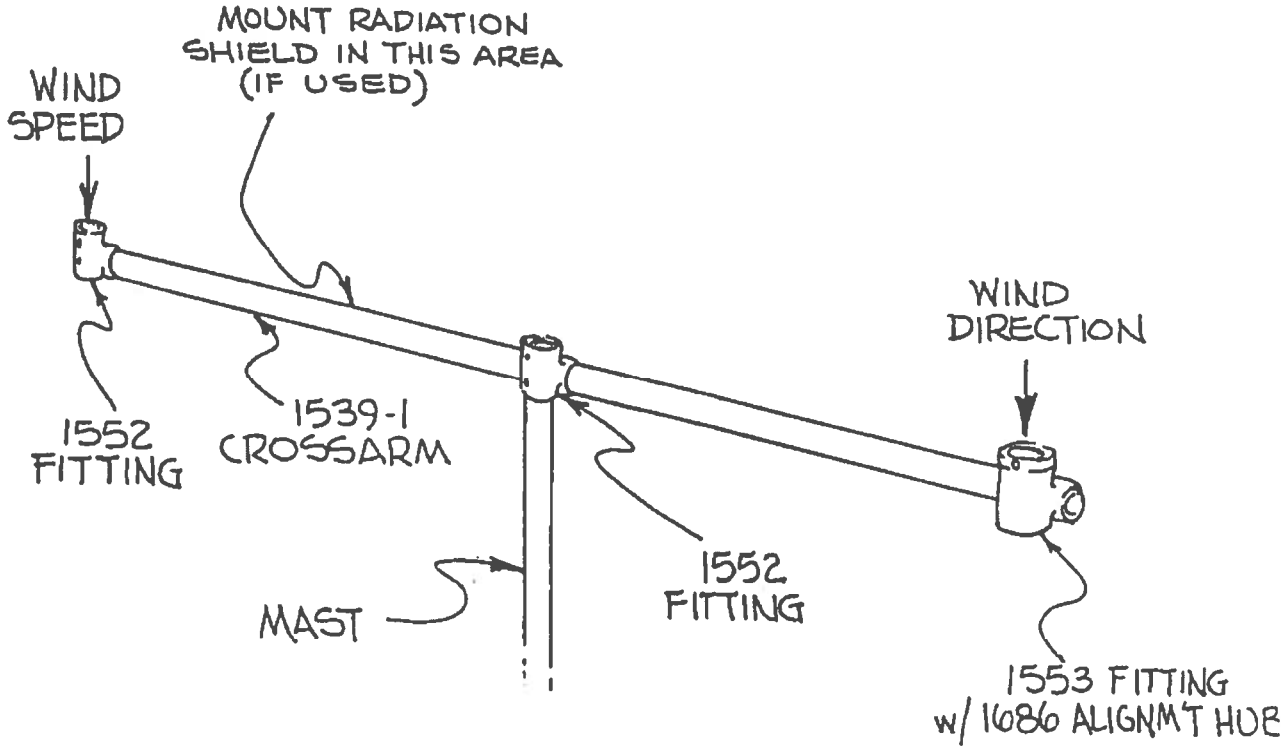
Figure #4 Anchor Grounding Kit Detail



INSTALLATION
193 UNIVERSAL MOUNT

24 JUN '92 RW MS

DWG # 6408



INSTALLATION
191-1 CROSSARM ASSY

MAR 1 1 1993

MET ONE NORTHWEST

9MAR93 RWMS

DRAWING NO. 6400-1

Relative Humidity Sensor

083C

The Model 083C sensor probe represents sensitivity, accuracy, linearity and stability not encountered with conventional relative humidity sensors. It is extremely well suited for meteorological, industrial, laboratory and other demanding applications.

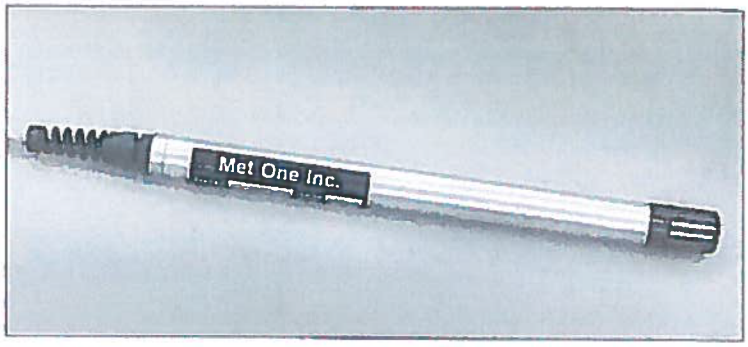
Features

- All solid state construction
- Fast response of less than five seconds
- Low power consumption of 4 ma at 12 VDC
- Easily cleaned using distilled water
- 0-1V output for 0-100% RH
- Will operate from a 12 VDC battery

The model 083C RH sensor can also be supplied with a Temperature Sensor mounted in it and used with various radiation shields for reliable, accurate measurements.

Operation

The model 083C Relative Humidity Sensor is based upon the capacitance change of a polymer thin film capacitor. A one-micron thick dielectric polymer layer absorbs water molecules through a thin metal electrode and causes capacitance change proportional to relative humidity. The thin polymer layer reacts very fast, and therefore, the response time is very short—less than five seconds to 90% of the final value of relative humidity. The sensor responds to the full range from 0-100% relative humidity. Its response is essentially linear, with small hysteresis, and negligible temperature dependence.



The Model 083C Relative Humidity Sensor is extremely well suited for meteorological, industrial, laboratory and other demanding applications.

Construction

The sensor is mounted in a small probe which contains all the electronics necessary to provide an output for indicating or recording humidity. Since the capacitance change of the sensor is sensitive only to the ambient humidity, temperature compensation is not required for most applications. The probe body is water tight and made from corrosion resistant aluminum. Immersion in water does not affect the calibration of the sensor.

The polymer material is resistant to most chemicals. The calibration of the sensor is not affected by liquid.

Specifications

Sensing Element:	Thin film capacitor
Range:	0-100% Relative Humidity
Temperature Range:	-20°C to +60°C
Response Time:	Less than 15 seconds at 68°F of Final (with filter)
Accuracy:	0-10% ±3% 10-90% ±2% 90-100% ±3%
Temperature Coefficient:	0.04% RH/°C
Output:	0-1.00 VDC - Standard
Input Power:	4 MA at 12 VDC Battery
Dimensions:	Diameter 0.75" Length 7.5"
Weight:	2.5 oz.

Subject to change without notice.

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http://www.metone.com

Ordering Information

083C – X – Y

– 0	Temperature Sensor not included
– 1	–50 to +50°C, 060 type Temperature Sensor included

– 1	With connector for direct use with Model 071 Vane Radiation Shield
– 35	With connector for direct use with Model 073B Radiation Shield or Model 075B Solar Powered Radiation Shield
– 6	With 6" Signal Cable for direct use with Model 076B Motor Aspirated Radiation Shield

MODEL 083C
RELATIVE HUMIDITY/TEMPERATURE SENSOR

OPERATION MANUAL

Met One
Instruments

1600 Washington Blvd.
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Facsimile 541-471-7116

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Rowlett, Texas 75088
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Facsimile 972-412-4716

083C RELATIVE HUMIDITY/TEMPERATURE SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 The 083C Sensor contains an extremely accurate and sensitive relative humidity sensor which responds to the full range of 0-100% humidity. Response is linear with small hysteresis and negligible temperature dependence. The sensor is designed to be housed in a radiation shield when used outdoors. Certain models also contain a high-accuracy linearized air temperature sensor, permitting simultaneous measurement of relative humidity and temperature.

1.2 The 083C Sensor model number describes the sensor options as follows:

083C - X - Y

X is the temperature option:

0 = no temperature sensor
1 = -50 to +50°C temperature sensor

Other temperature options are available.

Y is the radiation shield compatibility option:

-Y	Radiation Shield	Signal Cable
-1	071	1873-ZZ (ZZ = cable length in feet)
-6	076	2144-ZZ
-6	077	2408-ZZ
-35	073B	2348-ZZ
-35	075B	2348-ZZ

1.3 The Sensor Cable is vinyl-jacketed and shielded. Cable length is given in feet on each cable part number. The cable part number depends on which radiation shield the sensor is mounted in. The 077 Radiation Shield has a screw type terminal strip to accept wire leads from the 2408 cable. All other Radiation Shields and cables have Mil Spec screw-on or twist-on cable connectors.

The 083C-X-6 sensor mounts in either a 076B Radiation Shield, with a 2144-ZZ signal cable or a 077 Radiation Shield with a 2408-ZZ signal cable.

Table 1.1
Model 083C Relative Humidity Sensor Specifications

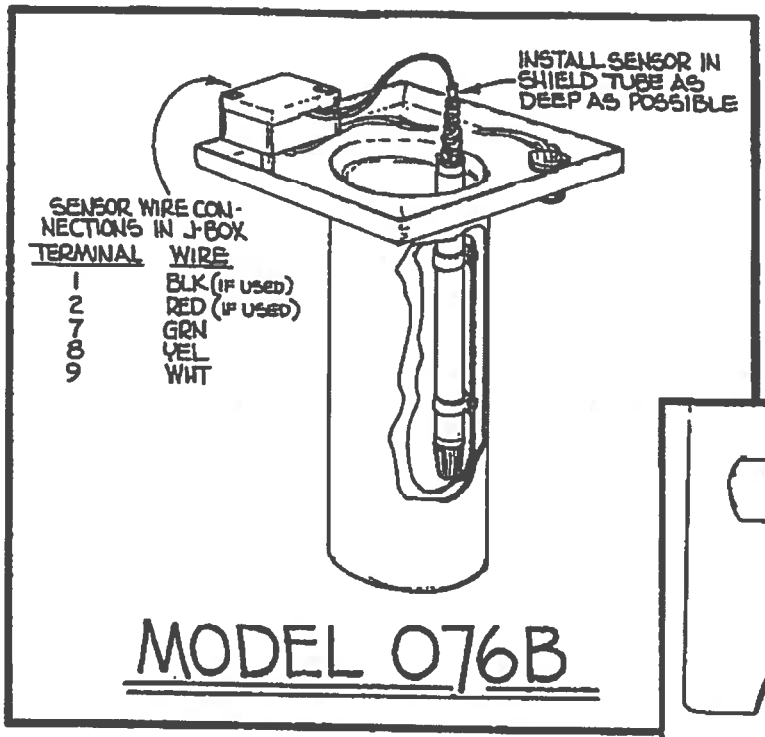
Sensing Element	Thin-film capacitor
Range	0-100% RH
Temperature Range	-20°F to +50°C
Response Time	15 seconds at 68°F 90% of final RH value
Accuracy	Better than ±3% between 10% and 90%
Hysteresis	For 0% to 100% to 0% excursion less than ±1%
Temperature Coefficient	±0.04% per 1°C
Output	0 - 1V at full scale (standard)
Input Power	12V DC ± 2V, 12 ma

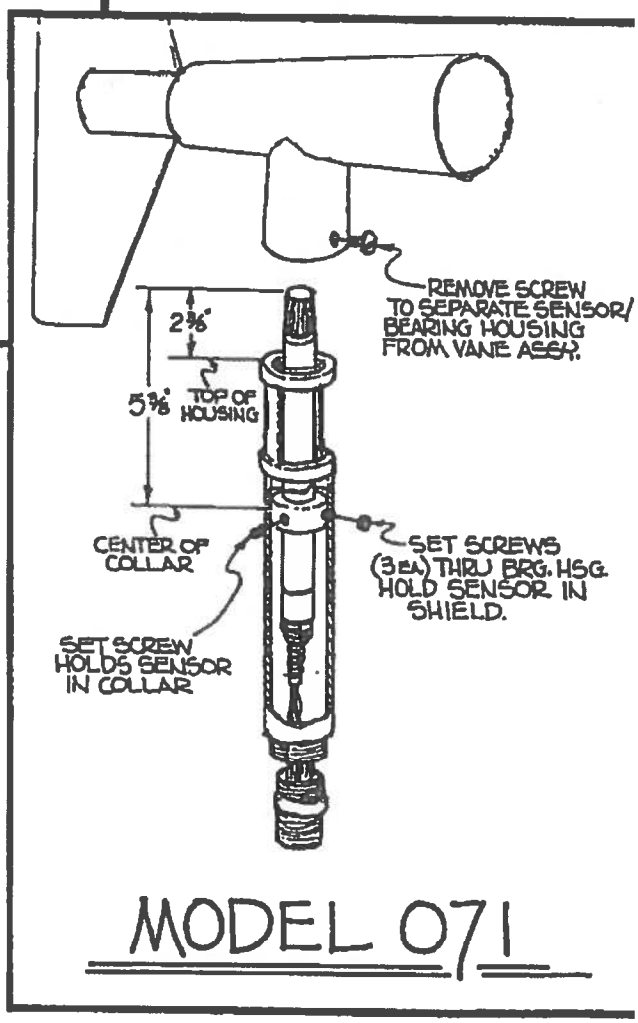
Table 1.2
Model 083C-1 RH/Temp Sensor Specifications

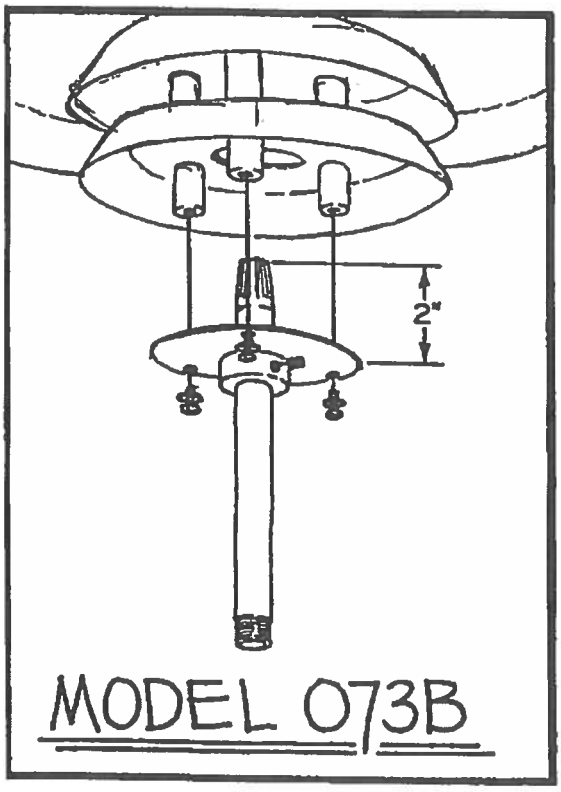
Range	-50° to +50°C (standard range)
Linearity	±0.15°C
Accuracy	±0.10°C
Time Constant	10 sec.

2.0 INSTALLATION

2.1 If sensor comes mounted in a radiation shield, refer to radiation shield manual section for mounting details. Sensors not furnished in a radiation shield should be mounted in a representative location having good air flow and shaded from sunlight or other heat radiation sources that would affect measurement of relative humidity or temperature.







TYPICAL 083C SENSOR INSTALLATIONS IN STANDARD RADIATION SHIELDS

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 Relative Humidity Measurement

3.2 Relative Humidity Sensor Check-out

1. To verify correct wiring and as a rough test of sensor operation, blow on the sensor. The relative humidity will rise to a higher level.

2. The Relative Humidity Sensor has been calibrated at the factory and will not change unless it is damaged. To check for proper operation of the sensor it is advised that the output signal be checked against a local weather service facility. Exact correlation is not to be expected due to atmospheric and geographical variations.

3.3 Temperature Sensor

1. Compare actual readings with precision mercury thermometer. As an alternative, measure sensor resistance with a Lo Current Digital Ohm Meter and compare readings of temperature vs resistance. See Table 3.1.

4.0 MAINTENANCE AND TROUBLE SHOOTING

4.1 General Maintenance Schedule*

6 - 12 Month Intervals:

A. Inspect sensors for proper operation per Section 3.0.

B. Clean Relative Humidity sensor element per Section 4.2A.

*Schedule is based on average to adverse environments.

4.2 083 Relative Humidity Sensor Maintenance and Calibration

Warning: The sensor can be miscalibrated or permanently damaged through improper acts. Do not attempt a repair or calibration if you are unsure of the procedure. Do not touch if you do not know how.

This instrument should operate for an extended period of time with a minimum of care or maintenance.

If parts or maintenance assistance are required, contact Met One Instruments. Obtain shipping instructions before returning any unit.

A. Maintenance

Cleaning the Sensor Element. Unscrew the filter. Dust and other particles may be removed by gently blowing on the sensor chip. DO NOT USE COMPRESSED AIR. After dusting, the sensor element may be wiped clean with a soft brush dipped in distilled water. DO NOT USE DETERGENTS. DO NOT APPLY POWER TO THE SENSOR WHEN CLEANING, and do not reconnect power to the sensor until the element has dried.

CAUTION: NEVER TOUCH THE SENSOR CHIP WITH BARE HANDS

1. The life of the sensor is related to the environment in which it operates. In a pure air and water vapor surrounding, the sensor element will have an indefinite life. The presence of chemical pollutants in the environment may corrode the materials of the sensor chip. The polymer material is resistant to most chemical attacks, but the metal electrodes, are sensitive to corrosion effects, particularly when a DC voltage is applied to the sensor. The most harmful pollutant has been sulphur dioxide absorption in small soot particles. When such particles fall on the thin metal electrode, they may, if water condensation is present, form traces of sulphuric acid to corrode the surface of the sensor. For these reasons, a careful cleaning as described in the preceding paragraph is recommended whenever the sensor has been exposed to corrosive pollutants. Also, a periodic cleaning every two weeks with an atomizer of distilled water, thoroughly washing the chip clean, may remove harmful particles before they can damage the sensor. Be sure that no power is applied when washing the chip and that power remains off until after the chip has dried.

2. Replacement of Sensor Element. If the sensor element has been damaged, it can be easily replaced. Disconnect power to the probe. Unscrew the filter. Un-solder the old chip and solder a new one in its place. The sensor chip is very delicate, so observe the following precautions. DO NOT TOUCH THE CHIP WITH BARE HANDS. Handle the chip only by gripping its lead with pliers. When soldering, hold the lead with the pliers to prevent the heat from the soldering operation from damaging the chip. Do not bump the chip when reinstating the protective grid.

3. After replacement of the sensor element, the humidity probe must be recalibrated.

B. Humidity Probe Calibration.

1. Before attempting to recalibrate the probe, make sure that the translator module containing the signal conditioning electronics is still properly calibrated. If 0% and 100% do not produce corresponding readings on the indicator, recalibrate the translator module.
2. The calibration method described in this instruction manual is based on the constant water vapor pressure over saturated salt solutions and constant temperature. Materials used for the calibration are Lithium Chloride (LiCl) and Sodium Chloride (NaCl). The former creates a humidity of approximately 13% and the latter approximately 76% in 68°F (20°C) ambient temperature. Both of these chemical agents are available from chemical suppliers. To guarantee accurate calibration, the salts must be of high purity.

TEST EQUIPMENT REQUIRED:

2 Calibration Bottles: HM-111-CG-L and HM-111-CB-N
Lithium Chloride Salts, Reagent Grade 1
Sodium Chloride, Reagent Grade 1
Thermometer to measure ambient temperature
Distilled water

3. Preparations for Calibration

Refer to instructions with the calibration bottles for mixing the solutions.

The calibration bottles can be used for up to one year without changing fresh chemicals. The bottles should be stored in a place with constant temperature, so as to have them ready for use with just a short preparation time. Do not shake the bottle with salt solution before use. Care should be taken to see that there are no droplets of salt solution inside the mouth piece of the bottle. This might affect the accuracy of the calibration. Do not get any salt solution on the sensor element directly.

TABLE 4-1
Calibration Tables

LITHIUM CHLORIDE

Ambient Temperature °C	10	15	20	25	30	35	40
Calibration Value % RH	14.3	13.8	13.4	13.0	12.8	12.7	12.6

SODIUM CHLORIDE

Ambient Temperature °C	10	15	20	25	30	35	40
Calibration Value % RH	75.2	75.3	75.5	75.8	75.6	75.5	75.4

C. CALIBRATION FOR LOW HUMIDITY (13% RH)

1. Unscrew the filter. Do not bump the sensor element while removing the grid.

2. Pull the rubber plug out of the lithium chloride (LiCl) bottle, and push the sensor probe in its place in the cork's sleeve. The sleeve is fitted with a safety flange and prohibits the probe from falling through.

3. Read the ambient room temperature.

4. Note the humidity percentage from the lithium chloride calibration table, which corresponds to the temperature in question.

5. After 1 hour, read the humidity value, If the reading differs from the table value, adjust R15, zero adjust.

6. After use, close the bottle tightly with the rubber plug.

D. CALIBRATION FOR HIGH HUMIDITY (76%)

Repeat the calibration procedure as described above, but now using the sodium chloride. Adjust R18 (span adjustment) if necessary.

E. Repeat steps C and D until no further adjustments are required.

MODEL 510070
RELATIVE HUMIDITY CALIBRATOR

1.0 GENERAL INFORMATION

1.1 Suitable for all probes. Calibration by means of lithium chloride and sodium chloride saturated salt solutions. Bottles for salt solutions in metal box providing stable temperature. Due to the minimal space of air above the salt solution no ventilation is needed. Solid construction. Humidity and Temperature scale for each salt solution printed on the box lid. A thermometer situated between the salt bottles in the box provides a very reliable calibration.

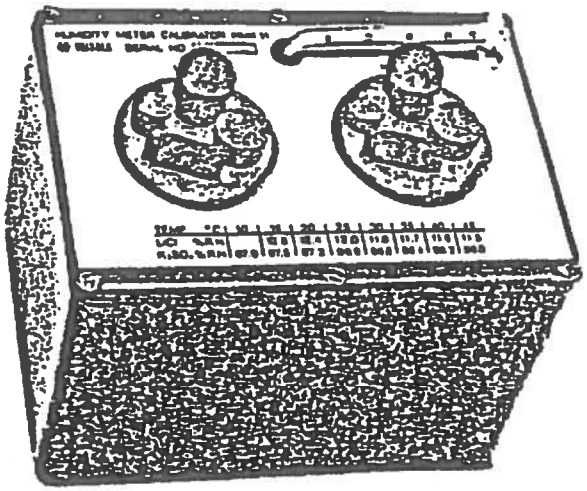
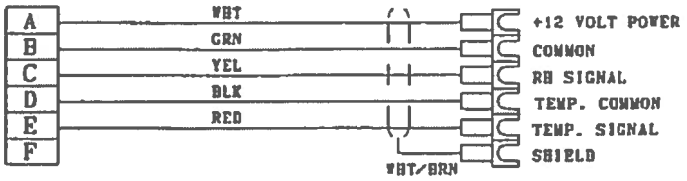
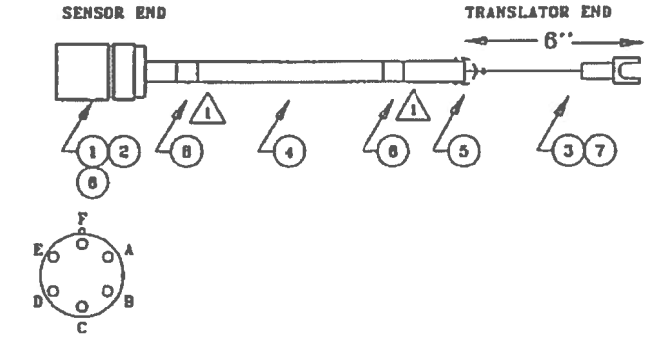


Figure 5
Calibrator before setting up

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN PER E.O. 1131	9/11/91	DH





ITEM	PART NO.	DESCRIPTION	QTY
1	500391	CONNECTOR, 8 PIN, FEMALE	1
2	480508	CLAMP	1
3	600193	LUG, SPADE, #8	8
4	400014	CABLE, 5 COND., SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	8"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

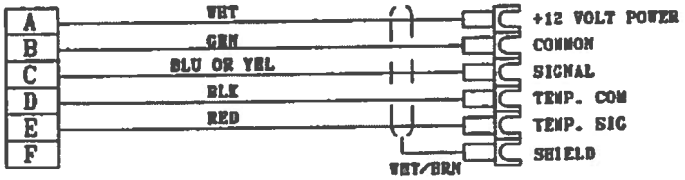
1. IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS

ASSY, CABLE, 083 RH AND TEMPERATURE

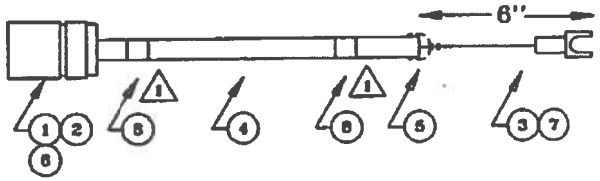
SIZE	FSCM NO.	DWG NO.	REV
		1873	C
SCALE		SHEET 1 OF 1	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD REL	5/21/92	DH
B	EO 1191	6/5/92	DH



SENSOR END

TRANSLATOR END



SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500351	CONNECTOR, 6 PIN, FEMALE	1
2	450500	CLAMP	1
3	500193	LUG, SPADE, #6	6
4	400014	CABLE, 5 COND., SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	950510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

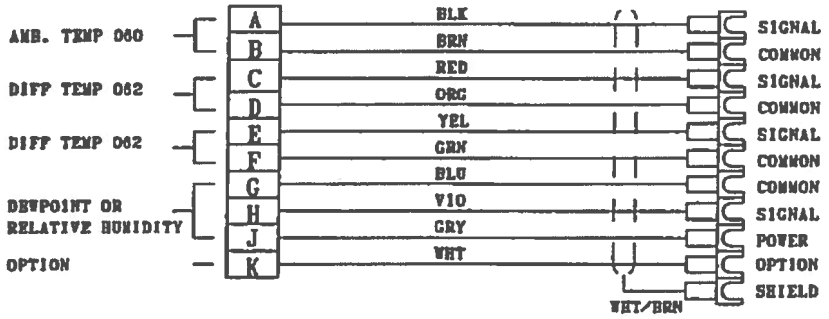
MET ONE INSTRUMENTS

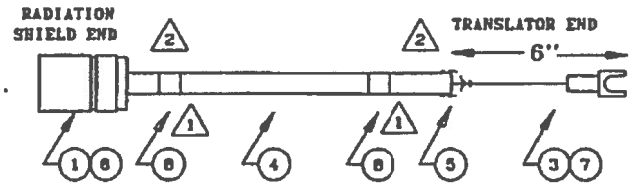
ASSY, CABLE, RELATIVE HUMIDITY AND TEMPERATURE

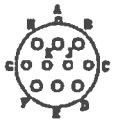
SIZE | DRGN NO. | DWG NO. 2348 | REV A

SCALE | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN AND ADD PARTS LIST	8/13/91	DH







SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500296	CONNECTOR, 10 PIN	1
2			
3	600193	LUG, SPADE, #6	6
4	400017	CABLE, 12 WIRE, SHIELDED	A/R
5	960096	SLEEVING, 3/8, SHRINK	A/R
6	960093	SLEEVING, 3/32, SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960065	SLEEVING, 1/2", CLEAR	A/R
9			
10			

1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET.

2. CUT OFF WHT/BRN AND WHT/BLK WIRES AT BOTH ENDS. SOLDER WHT/BRN WIRE TO SHIELD ON TRANSLATOR END. USE ITEM 6 TO COVER SOLDER JOINT ON SHEILD.

MET ONE INSTRUMENTS

ASSY, CABLE, SIGNAL OUT, 076B /JUNCTION BOX

SIZE	PSCN NO.	DWG NO.	REV
		2144	D

SCALE | SHEET 1 OF 1

MODEL 077 RADIATION SHIELD
WIRING TABLE
CABLE NO. 2408

COLOR	USE
RED	AT SIG
BLACK	AT COM
GREEN	RH COM
WHITE	RH +12V
YELLOW	RH SIG
WHT/BRN	SHIELD

MODEL 077 RADIATION SHIELD
WIRING TABLE
CABLE NO. 2409

COLOR	USE
RED	POWER
BLACK	COM

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG C	RNOM*	RCAL	TEMP DEG C	RNOM*	RCAL
0	2768.230	20516.330	50	1912.480	4753.275
1	2751.115	19612.079	51	1895.365	4648.939
2	2734.000	18774.249	52	1878.250	4547.305
3	2716.885	17995.782	53	1861.135	4448.269
4	2699.770	17270.584	54	1844.020	4351.734
5	2682.655	16593.368	55	1826.905	4257.605
6	2665.540	15959.526	56	1809.790	4165.794
7	2648.425	15365.018	57	1792.675	4076.216
8	2631.310	14806.295	58	1775.560	3988.790
9	2614.195	14280.220	59	1758.445	3903.440
10	2597.080	13784.011	60	1741.330	3820.094
11	2579.965	13315.197	61	1724.215	3738.680
12	2562.850	12871.569	62	1707.100	3659.133
13	2545.735	12451.151	63	1689.985	3581.390
14	2528.620	12052.167	64	1672.870	3505.389
15	2511.505	11673.020	65	1655.755	3431.072
16	2494.390	11312.266	66	1638.640	3358.385
17	2477.275	10968.598	67	1621.525	3287.274
18	2460.160	10640.830	68	1604.410	3217.689
19	2443.045	10327.885	69	1587.295	3149.580
20	2425.930	10028.778	70	1570.180	3082.902
21	2408.815	9742.611	71	1553.065	3017.610
22	2391.700	9468.564	72	1535.950	2953.661
23	2374.585	9205.881	73	1518.835	2891.014
24	2357.470	8953.870	74	1501.720	2829.630
25	2340.355	8711.894	75	1484.605	2769.471
26	2323.240	8479.365	76	1467.490	2710.500
27	2306.125	8255.740	77	1450.375	2652.683
28	2289.010	8040.519	78	1433.260	2595.986
29	2271.895	7833.234	79	1416.145	2540.377
30	2254.780	7633.457	80	1399.030	2485.825
31	2237.665	7440.785	81	1381.915	2432.300
32	2220.550	7254.847	82	1364.800	2379.773
33	2203.435	7075.296	83	1347.685	2328.217
34	2186.320	6901.807	84	1330.570	2277.605
35	2169.205	6734.080	85	1313.455	2227.912
36	2152.090	6571.832	86	1296.340	2179.112
37	2134.975	6414.798	87	1279.225	2131.181
38	2117.860	6262.731	88	1262.110	2084.098
39	2100.745	6115.400	89	1244.995	2037.838
40	2083.630	5972.586	90	1227.880	1992.382
41	2066.515	5834.085	91	1210.765	1947.708
42	2049.400	5699.705	92	1193.650	1903.795
43	2032.285	5569.263	93	1176.535	1860.626
44	2015.170	5442.590	94	1159.420	1818.181
45	1998.055	5319.525	95	1142.305	1776.442
46	1980.940	5199.915	96	1125.190	1735.392
47	1963.825	5083.617	97	1108.075	1695.013
48	1946.710	4970.495	98	1090.960	1655.290
49	1929.595	4860.422	99	1073.845	1616.206
50	1912.480	4753.275	100	1056.730	1577.746

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 0 TO 100 DEGREE C
THERMISTOR BEAD 44201
RNOM = (-17.115)T+2768.23 WHERE T = TEMPERATURE IN DEGREE CENTIGRADE

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
32	2768.224	20516.001	84	2273.808	7856.023
33	2758.716	20005.011	85	2264.300	7743.679
34	2749.208	19515.576	86	2254.792	7633.594
35	2739.700	19046.361	87	2245.284	7525.703
36	2730.192	18596.138	88	2235.776	7419.939
37	2720.684	18163.777	89	2226.268	7316.241
38	2711.176	17748.235	90	2216.760	7214.548
39	2701.668	17348.550	91	2207.252	7114.803
40	2692.160	16963.831	92	2197.744	7016.951
41	2682.652	16593.253	93	2188.236	6920.937
42	2673.144	16236.051	94	2178.728	6826.712
43	2663.636	15891.512	95	2169.220	6734.225
44	2654.128	15558.976	96	2159.712	6643.428
45	2644.620	15237.826	97	2150.204	6554.276
46	2635.112	14927.487	98	2140.696	6466.725
47	2625.604	14627.422	99	2131.188	6380.731
48	2616.096	14337.129	100	2121.680	6296.253
49	2606.588	14056.139	101	2112.172	6213.253
50	2597.080	13784.011	102	2102.664	6131.691
51	2587.572	13520.333	103	2093.156	6051.530
52	2578.064	13264.717	104	2083.648	5972.734
53	2568.556	13016.798	105	2074.140	5895.269
54	2559.048	12776.235	106	2064.632	5819.102
55	2549.540	12542.705	107	2055.124	5744.200
56	2540.032	12315.904	108	2045.616	5670.532
57	2530.524	12095.545	109	2036.108	5598.067
58	2521.016	11881.357	110	2026.600	5526.777
59	2511.508	11673.085	111	2017.092	5456.633
60	2502.000	11470.487	112	2007.584	5387.607
61	2492.492	11273.335	113	1998.076	5319.673
62	2482.984	11081.411	114	1988.568	5252.806
63	2473.476	10894.510	115	1979.060	5186.981
64	2463.968	10712.439	116	1969.552	5122.172
65	2454.460	10535.011	117	1960.044	5058.358
66	2444.952	10362.052	118	1950.536	4995.514
67	2435.444	10193.394	119	1941.028	4933.620
68	2425.936	10028.880	120	1931.520	4872.654
69	2416.428	9868.359	121	1922.012	4812.595
70	2406.920	9711.686	122	1912.504	4753.423
71	2397.412	9558.726	123	1902.996	4695.118
72	2387.904	9409.347	124	1893.488	4637.662
73	2378.396	9263.425	125	1883.980	4581.037
74	2368.888	9120.842	126	1874.472	4525.223
75	2359.380	8981.485	127	1864.964	4470.205
76	2349.872	8845.245	128	1855.456	4415.965
77	2340.364	8712.019	129	1845.948	4362.487
78	2330.856	8581.707	130	1836.440	4309.754
79	2321.348	8454.216	131	1826.932	4257.752
80	2311.840	8329.454	132	1817.424	4206.464
81	2302.332	8207.335	133	1807.916	4155.878
82	2292.824	8087.777	134	1798.408	4105.978
83	2283.316	7970.698	135	1788.900	4056.750

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 32 TO 212 DEGREE FARENHEIT
THERMISTOR BEAD 44201
RNOM = (-9.508)T+3072.48 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
136	1779.392	4008.181	178	1380.056	2426.547
137	1769.884	3960.258	179	1370.548	2397.305
138	1760.376	3912.968	180	1361.040	2368.365
139	1750.868	3866.299	181	1351.532	2339.723
140	1741.360	3820.238	182	1342.024	2311.374
141	1731.852	3774.774	183	1332.516	2283.313
142	1722.344	3729.894	184	1323.008	2255.537
143	1712.836	3685.589	185	1313.500	2228.041
144	1703.328	3641.846	186	1303.992	2200.821
145	1693.820	3598.656	187	1294.484	2173.872
146	1684.312	3556.008	188	1284.976	2147.191
147	1674.804	3513.891	189	1275.468	2120.774
148	1665.296	3472.296	190	1265.960	2094.616
149	1655.788	3431.214	191	1256.452	2068.715
150	1646.280	3390.634	192	1246.944	2043.065
151	1636.772	3350.548	193	1237.436	2017.664
152	1627.264	3310.947	194	1227.928	1992.508
153	1617.756	3271.821	195	1218.420	1967.594
154	1608.248	3233.163	196	1208.912	1942.917
155	1598.740	3194.964	197	1199.404	1918.475
156	1589.232	3157.216	198	1189.896	1894.264
157	1579.724	3119.911	199	1180.388	1870.281
158	1570.216	3083.041	200	1170.880	1846.523
159	1560.708	3046.599	201	1161.372	1822.986
160	1551.200	3010.577	202	1151.864	1799.668
161	1541.692	2974.969	203	1142.356	1776.565
162	1532.184	2939.766	204	1132.848	1753.675
163	1522.676	2904.962	205	1123.340	1730.995
164	1513.168	2870.551	206	1113.832	1708.521
165	1503.660	2836.526	207	1104.324	1686.252
166	1494.152	2802.880	208	1094.816	1664.183
167	1484.644	2769.606	209	1085.308	1642.313
168	1475.136	2736.700	210	1075.800	1620.638
169	1465.628	2704.154	211	1066.292	1599.157
170	1456.120	2671.964	212	1056.784	1577.867
171	1446.612	2640.122			
172	1437.104	2608.624			
173	1427.596	2577.464			
174	1418.088	2546.636			
175	1408.580	2516.136			
176	1399.072	2485.957			
177	1389.564	2456.096			

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 32 TO 212 DEGREE FARENHEIT
THERMISTOR BEAD 44201
RNOM = (-9.508)T+3072.48 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

TABLE 3.1b

MODELS 060A-2, 063-1, 064-2

TEMP DEG C	RNOM*	RCAL	TEMP DEG C	RNOM*	RCAL
-50	20156.450	158181.106	1	13569.137	32887.585
-49	20027.287	150560.866	2	13439.974	32138.982
-48	19898.124	143555.423	3	13310.811	31410.134
-47	19768.961	137093.261	4	13181.648	30700.268
-46	19639.798	131113.540	5	13052.485	30008.654
-45	19510.635	125564.179	6	12923.322	29334.596
-44	19381.472	120400.331	7	12794.159	28677.434
-43	19252.309	115583.174	8	12664.996	28036.540
-42	19123.146	111078.926	9	12535.833	27411.318
-41	18993.983	106858.059	10	12406.670	26801.200
-40	18864.820	102894.645	11	12277.507	26205.645
-39	18735.657	99165.826	12	12148.344	25624.138
-38	18606.494	95651.371	13	12019.181	25056.188
-37	18477.331	92333.314	14	11890.018	24501.325
-36	18348.168	89195.637	15	11760.855	23959.104
-35	18219.005	86224.021	16	11631.692	23429.096
-34	18089.842	83405.623	17	11502.529	22910.893
-33	17960.679	80728.891	18	11373.366	22404.106
-32	17831.516	78183.405	19	11244.203	21908.362
-31	17702.353	75759.744	20	11115.040	21423.303
-30	17573.190	73449.366	21	10985.877	20948.587
-29	17444.027	71244.510	22	10856.714	20483.888
-28	17314.864	69138.108	23	10727.551	20028.891
-27	17185.701	67123.710	24	10598.388	19583.296
-26	17056.538	65195.417	25	10469.225	19146.814
-25	16927.375	63347.824	26	10340.062	18719.169
-24	16798.212	61575.968	27	10210.899	18300.095
-23	16669.049	59875.286	28	10081.736	17889.336
-22	16539.886	58241.574	29	9952.573	17486.649
-21	16410.723	56670.953	30	9823.410	17091.796
-20	16281.560	55159.837	31	9694.247	16704.553
-19	16152.397	53704.907	32	9565.084	16324.700
-18	16023.234	52303.087	33	9435.921	15952.028
-17	15894.071	50951.521	34	9306.758	15586.336
-16	15764.908	49647.554	35	9177.595	15227.430
-15	15635.745	48388.715	36	9048.432	14875.121
-14	15506.582	47172.702	37	8919.269	14529.231
-13	15377.419	45997.365	38	8790.106	14189.584
-12	15248.256	44860.698	39	8660.943	13856.015
-11	15119.093	43760.822	40	8531.780	13528.360
-10	14989.930	42695.980	41	8402.617	13206.464
-9	14860.767	41664.524	42	8273.454	12890.176
-8	14731.604	40664.908	43	8144.291	12579.352
-7	14602.441	39695.681	44	8015.128	12273.850
-6	14473.278	38755.477	45	7885.965	11973.536
-5	14344.115	37843.011	46	7756.802	11678.278
-4	14214.952	36957.076	47	7627.639	11387.949
-3	14085.789	36096.529	48	7498.476	11102.428
-2	13956.626	35260.295	49	7369.313	10821.595
-1	13827.463	34447.357	50	7240.150	10545.337
0	13698.300	33656.757			

* VALUE WITH 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE -50 TO +50C OR -58 TO +122F
THERMISTOR BEAD 44212
RNOM=(-129.163)T + 13698.3 WHERE T = TEMPERATURE IN DEGREE CENTEGRADE

For RCAL:

$Tc = ((((R+^{-1}) + (23100^{-1}))^{-1} - 13698.3)/-129.163$

$Rt = ((((-129.163Tc) + 13698.3)^{-1}) - (23100)^{-1})^{-1}$

Where: Tc = Temp (deg C
RT = RCAL

TABLE 3.1B

MODELS 060A-2, 063-1, 064-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
-58	20156.406	158178.396	1	15922.743	51247.345
-57	20084.649	153864.473	2	15850.986	50511.390
-56	20012.892	149751.096	3	15779.229	49789.864
-55	19941.135	145824.598	4	15707.472	49082.344
-54	19869.378	142072.527	5	15635.715	48388.428
-53	19797.621	138483.513	6	15563.958	47707.726
-52	19725.864	135047.152	7	15492.201	47039.866
-51	19654.107	131753.909	8	15420.444	46384.486
-50	19582.350	128595.024	9	15348.687	45741.240
-49	19510.593	125562.439	10	15276.930	45109.795
-48	19438.836	122648.729	11	15205.173	44489.828
-47	19367.079	119847.038	12	15133.416	43881.030
-46	19295.322	117151.028	13	15061.659	43283.101
-45	19223.565	114554.830	14	14989.902	42695.752
-44	19151.808	112053.002	15	14918.145	42118.707
-43	19080.051	109640.490	16	14846.388	41551.694
-42	19008.294	107312.596	17	14774.631	40994.456
-41	18936.537	105064.943	18	14702.874	40446.742
-40	18864.780	102893.455	19	14631.117	39908.309
-39	18793.023	100794.323	20	14559.360	39378.924
-38	18721.266	98763.991	21	14487.603	38858.361
-37	18649.509	96799.130	22	14415.846	38346.400
-36	18577.752	94896.625	23	14344.089	37842.831
-35	18505.995	93053.552	24	14272.332	37347.448
-34	18434.238	91267.171	25	14200.575	36860.054
-33	18362.481	89534.904	26	14128.818	36380.456
-32	18290.724	87854.331	27	14057.061	35908.471
-31	18218.967	86223.170	28	13985.304	35443.916
-30	18147.210	84639.274	29	13913.547	34986.620
-29	18075.453	83100.619	30	13841.790	34536.411
-28	18003.696	81605.292	31	13770.033	34093.128
-27	17931.939	80151.490	32	13698.276	33656.612
-26	17860.182	78737.507	33	13626.519	33226.708
-25	17788.425	77361.727	34	13554.762	32803.268
-24	17716.668	76022.625	35	13483.005	32386.147
-23	17644.911	74718.752	36	13411.248	31975.205
-22	17573.154	73448.737	37	13339.491	31570.305
-21	17501.397	72211.277	38	13267.734	31171.314
-20	17429.640	71005.136	39	13195.977	30778.106
-19	17357.883	69829.141	40	13124.220	30390.554
-18	17286.126	68682.175	41	13052.463	30008.538
-17	17214.369	67563.176	42	12980.706	29631.940
-16	17142.612	66471.134	43	12908.949	29260.645
-15	17070.855	65405.087	44	12837.192	28894.542
-14	16999.098	64364.116	45	12765.435	28533.523
-13	16927.341	63347.348	46	12693.678	28177.483
-12	16855.584	62353.948	47	12621.921	27826.320
-11	16783.827	61383.120	48	12550.164	27479.933
-10	16712.070	60434.103	49	12478.407	27138.227
-9	16640.313	59506.170	50	12406.650	26801.107
-8	16568.556	58598.626	51	12334.893	26468.481
-7	16496.799	57710.807	52	12263.136	26140.260
-6	16425.042	56842.076	53	12191.379	25816.357
-5	16353.285	55991.825	54	12119.622	25496.688
-4	16281.528	55159.469	55	12047.865	25181.169
-3	16209.771	54344.451	56	11976.108	24869.721
-2	16138.014	53546.233	57	11904.351	24562.266
-1	16066.257	52764.302	58	11832.594	24258.727
0	15994.500	51998.163	59	11760.837	23959.029

*VALUE WITH A 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE = -58 TO +122 DEGREE FARENHEIT.
THERMISTOR BEAD = 44212
RNOM = $(-71.757)T + 15994.5$ WHERE T = TEMPERATURE IN DEGREE FARENHEIT

TABLE 3.1B

MODELS 060A-2, 063-1, 064-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
60	11689.080	23663.101	101	8747.043	14077.705
61	11617.323	23370.871	102	8675.286	13892.761
62	11545.566	23082.271	103	8603.529	13709.648
63	11473.809	22797.233	104	8531.772	13528.339
64	11402.052	22515.693	105	8460.015	13348.808
65	11330.295	22237.585	106	8388.258	13171.028
66	11258.538	21962.848	107	8316.501	12994.973
67	11186.781	21691.420	108	8244.744	12820.620
68	11115.024	21423.243	109	8172.987	12647.942
69	11043.267	21158.258	110	8101.230	12476.917
70	10971.510	20896.408	111	8029.473	12307.521
71	10899.753	20637.639	112	7957.716	12139.730
72	10827.996	20381.896	113	7885.959	11973.522
73	10756.239	20129.126	114	7814.202	11808.874
74	10684.482	19879.278	115	7742.445	11645.765
75	10612.725	19632.301	116	7670.688	11484.173
76	10540.968	19388.147	117	7598.931	11324.077
77	10469.211	19146.767	118	7527.174	11165.457
78	10397.454	18908.114	119	7455.417	11008.292
79	10325.697	18672.142	120	7383.660	10852.561
80	10253.940	18438.806	121	7311.903	10698.247
81	10182.183	18208.063	122	7240.146	10545.329
82	10110.426	17979.869			
83	10038.669	17754.182			
84	9966.912	17530.962			
85	9895.155	17310.168			
86	9823.398	17091.760			
87	9751.641	16875.700			
88	9679.884	16661.951			
89	9608.127	16450.476			
90	9536.370	16241.238			
91	9464.613	16034.203			
92	9392.856	15829.335			
93	9321.099	15626.601			
94	9249.342	15425.968			
95	9177.585	15227.402			
96	9105.828	15030.873			
97	9034.071	14836.350			
98	8962.314	14643.801			
99	8890.557	14453.196			
100	8818.800	14264.507			

*VALUE WITH A 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE = -58 TO +122 DEGREE FARENHEIT
THERMISTOR BEAD = 44212
RNOM = (-71.757)T +15994.5 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

Wind Direction Sensor

024A

The Model 024A Wind Direction Sensor is an accurate, durable and economical sensor suitable for a wide range of wind study applications. It is designed for long-term unattended operation in most meteorological environments.

Features

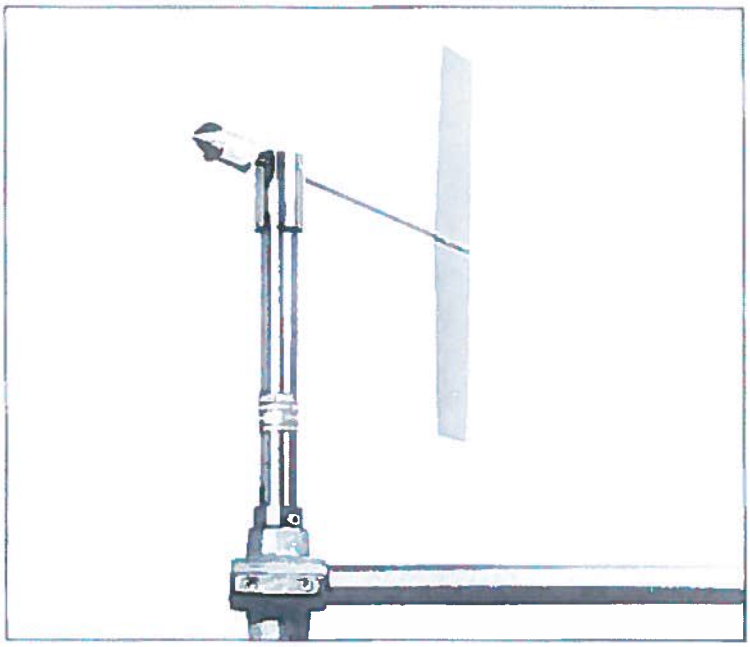
- Range to 100 mph
- Low starting threshold
- Broad temperature operating range
- Built-in alignment and calibration feature
- Accuracy of ±5°
- Stainless steel and aluminum construction

Operation

The sensor incorporates a precision wire-wound potentiometer for accurate resolution of wind direction. The potentiometer is directly coupled to the vane assembly. Variations in wind direction produce a corresponding varying voltage, which lends itself to both digital and analog measurement systems.

Construction

The construction of the sensor reflects the requirement for reliability and durability. Only the best corrosion resistant materials, such as stainless steel and anodized aluminum are used. The potentiometer meets stringent military specifications for sand, dust, salt spray and fungus resistance. The Model 024A sensor uses a quick-connect sensor cable. Cable length may extend hundreds of feet without affecting measurement performance.



Accuracy, reliability and economy make the model 024A Wind Direction Sensor an ideal choice for most applications.

Specifications

Range	0-360°
Starting threshold	1 mph
Accuracy	±5°
Delay distance	<5 feet
Damping ratio	
Standard	0.25 (metal vane ass'y)
Fast Response	0.4 (foam vane ass'y)
Potentiometer	
Sand, dust, fungus	MIL-E-5272
Salt spray	MIL-E-12934
Electrical range	0-360°
	0-540° with appropriate translator
Operating range	-50° C to +70° C
Weight	1 lb 2 oz
Mounting	Model 191 Cross Arm

Ordering Information

Standard Model	024A (Metal Vane)
Fast Response Model	024A-1 (Foam Vane)
Cable	#1806-xx (xx = length in feet)

Met One Instruments, Inc.

Corporate Sales & Service: 1600 Washington Blvd , Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

MODEL 024A
WIND DIRECTION SENSOR

OPERATION MANUAL
Document No. 024A-9800

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024 WIND DIRECTION SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 The Met One 024A Wind Direction Sensor uses a lightweight, air-foil vane and a potentiometer to produce an output that varies proportional to wind direction.

1.2 The Sensor Cable has a quick-connect connector with vinyl-jacketed, shielded cable. Cable length is given in -XX feet on each cable part number. An 1806-XX cable is used with translators having terminal strip connections, and an 1809-XX cable is used with translators having circular MS type connectors.

TABLE 1-1
Model 024A Wind Direction Sensor Specifications

Performance Characteristics	
Azimuth	Electrical 0-356°* Mechanical 0-360°
Threshold	1.0 mph
Accuracy	±5°
Damping Ratio	Standard 0.25 Optional 0.4
Potentiometer Specs.	
	Sand, Dust, Fungus MIL-E-5272 Salt Spray MIL-E-12934
Temperature Range	-50° C to +70° C
Delay Distance	5 ft.
Electrical Characteristics	
Output Signal	Varying resistance 0-10 K ohms
Physical Characteristics	
Weight	1.5 pounds
Finish	Anodized
Mounting Fixtures	Use with 191 Crossarm
Cabling	3-Conductor Shielded Type Cable, xx is cable length in feet

CAUTION: THIS POTENTIOMETER HAS A SHORTING GAP WIPER. ANY VOLTAGE APPLIED TO THE SENSOR MUST BE CURRENT LIMITED TO 5 MILLIAMPS.

2.0 INSTALLATION

2.1 024A Wind Direction Sensor Installation (See FIGURE 2-1)

A. Prior to installing the wind direction sensor on the crossarm remove the stainless steel screw from the hub and rotate the vane assembly slowly. It should rotate smoothly without hesitation or binding. Inspect the vane assembly to be sure it is not bent or damaged. Replace the screw in the hub.

B. Install the sensor in the bushing end of the mounting arm. The screw in the bushing will pass through the bushing and will tighten into the sensor housing.

C. Loosen the two set screws holding bushing and orient the sensor so that the counterweight is pointing south. The use of a transit/compass will assure accurate alignment. When the sensor is properly aligned tighten the crossarm fitting set screws and remove the stainless steel screw from the hub. The sensor may be removed and replaced without realignment by removing the mounting screw in the alignment bushing.

D. Remove and retain shoulder screw (11). Check to see that the vane assembly rotates freely.Rotate the sensor assembly until the counterweight is pointing due south.

E. Connect the cable assembly to the keyed sensor receptacle and tape it to the mounting arm.

2.2 Wiring. The cable assembly contains three wires. Typical wiring hookup is shown in FIGURE 2-1.

2.3 Lightning Protection. Weather sensors are sensitive to direct or nearby lightning strikes. A well-grounded metal rod or frame should be placed above the sensor installation. In addition, the shield on the signal cable leading to the translator must be connected to be a good earth ground at the translator end, and the cable route should not be vulnerable to lightning.

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 024 Wind Direction Sensor Check-Out

A. Rotating the vane in a clockwise direction as viewed from above will increase the output up to the 360° point and it will start over 0°.

B. The 024A wind direction sensor should be inspected periodically for physical damage to the vane assembly and cable connections. Inspect all vane assembly parts to be sure that they are securely fastened. Inspect the sensor connector and mating cable connector for corrosion.

4.0 MAINTENANCE

4.1 General Maintenance Schedule*

6-12 Month Intervals:

A. Inspect sensor for proper operation per Section 3.0.

24-36 Month Intervals:

A. Factory replacement of potentiometer per Section 4.

B. Recommended complete factory overhaul of sensor.

4.2 POTENTIOMETER REPLACEMENT

4.3 Remove the sensor from the crossarm and remove the vane assembly. Replacement of the potentiometer will require realignment with respect to 180 degrees. Use the following procedure to replace and realign the potentiometer.

A) Loosen the three set screws which hold the potentiometer in the sensor housing. Pull the potentiometer up and out of the housing.

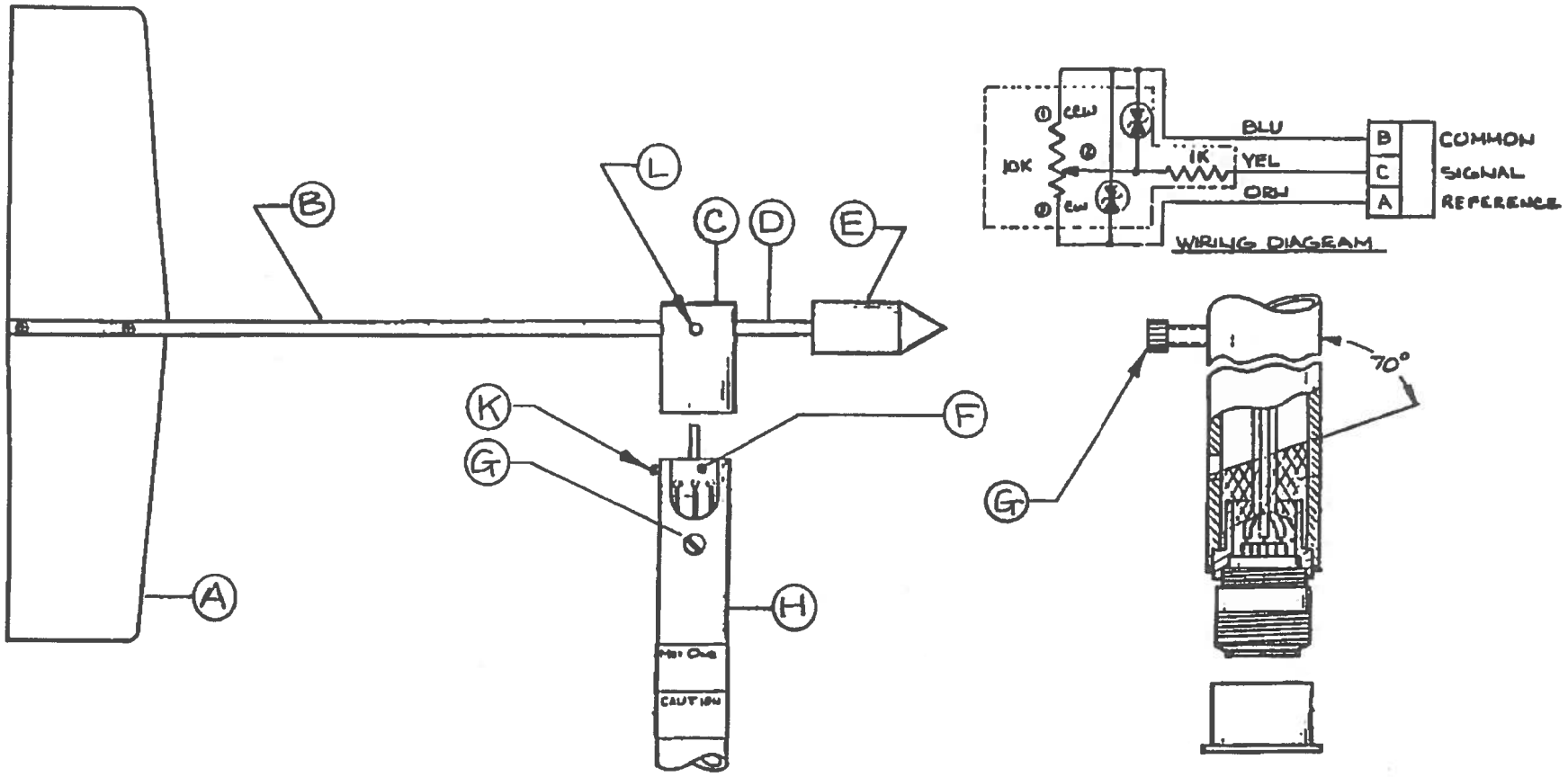
B) Remove the three wires from the potentiometer assembly. Note the color code of the wires with respect to the pins on the potentiometer. (See the 024A Assy. Dwg.)

C) Solder the wires to the new potentiometer and install the potentiometer in the sensor housing.

D) Connect the ohmmeter across pins B and C on the sensor connector. Install the vane assembly and the stainless steel hub alignment screw. Do not tighten the two hub set screws at this time. Insert a small screwdriver in the access hole in the top of the hub and rotate the potentiometer until the resistance measured across pins B and C is equal to the resistance across pins A and C (approx. 6k ohms). Tighten the two set screws carefully. The potentiometer position will tend to move slightly as these screws are tightened.

4.4 RECOMMENDED SPARE PARTS LIST (Refer to Drawing #024A)

Ref	Part No.	Description
A	2089	Aluminum Vane
B	2088	Vane Arm for Aluminum Vane
A,B	1286	Foam Vane and Arm Assy
C	1685-10	Hub
D	1814-1	Counterweight Arm for Aluminum Tail
D	1814-2	Counterweight Arm for Foam Tail
E	1057	Counterweight
A-E	2105	Aluminum Vane Assy, Complete
A-E	2106	Foam Vane Assy, Complete
F	2017	Potentiometer Assy
G	860015	Shoulder Screw
-	601625	8-32 x1/4 Set Screw
L	601680	8-32 x 3/8 Set Screw
K	601070	2-56 x 1/8 Screw



Wind Direction Sensor Model 024A

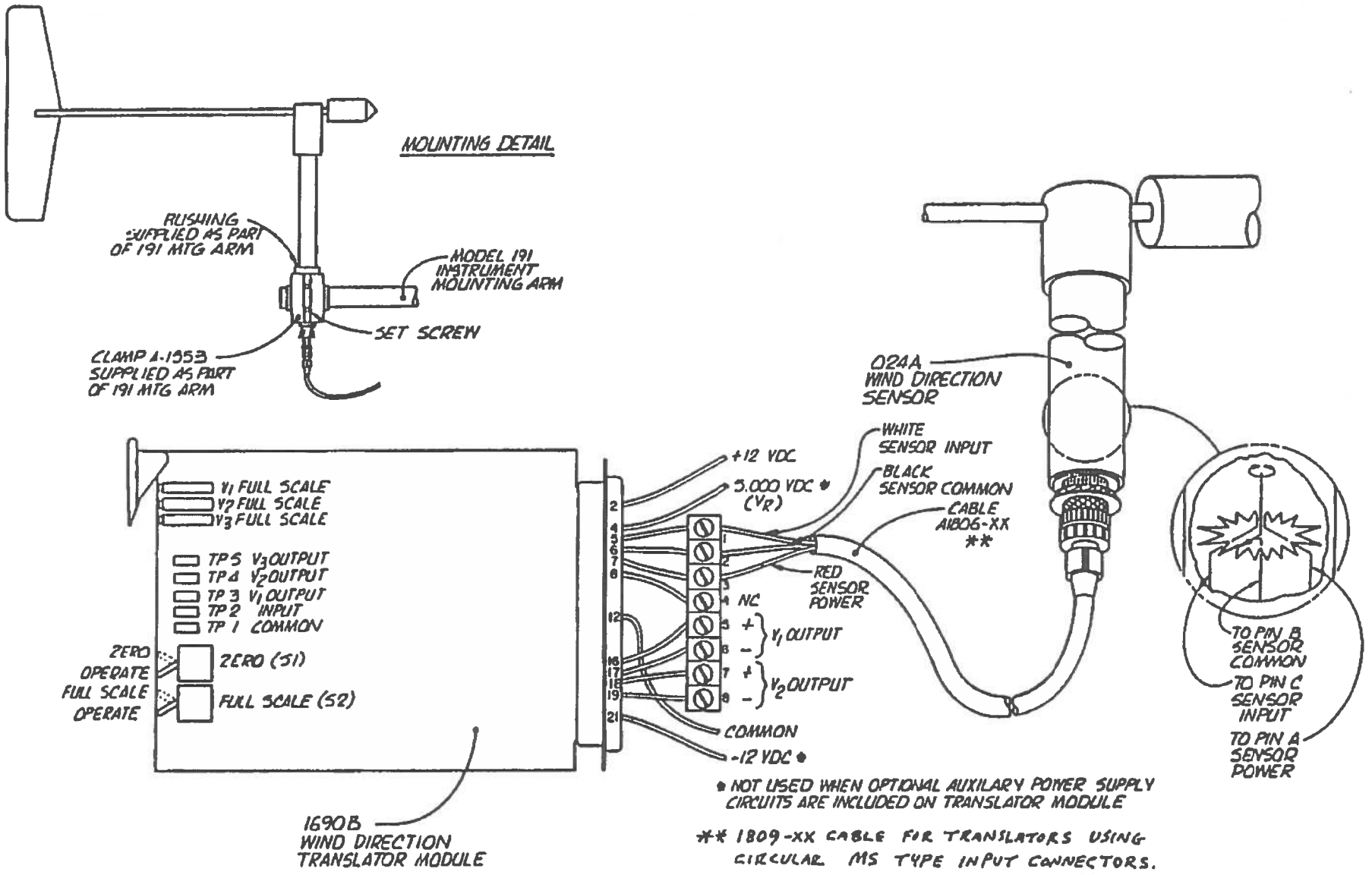
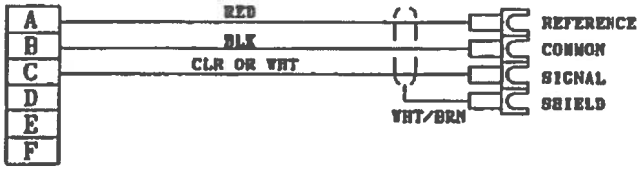


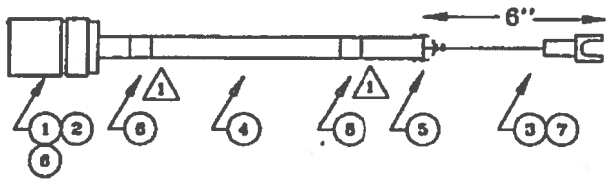
FIGURE 2-1. TYPICAL 024A INSTALLATION

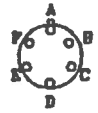
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN PER E.O. 1131	9/11/91	DH
E	WIRE COLORS	10/17/91	DH



SENSOR END

TRANSLATOR END





SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500351	CONNECTOR, 6 PIN, FEMALE	1
2	480500	CLAMP	1
3	600193	LUG, SPADE, #6	4
4	400011	CABLE, 3 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	960510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS

ASSY, CABLE, 024 WIND DIRECTION SENSOR

SIZE	FSCM NO.	DWG NO.	REV
		1806	E
SCALE		SHEET 1 OF 1	

Evaporation Gauge

550502

Features

- Simple data collecting
- High resolution
- Analog output
- Corrosion resistant
- Range 0-8"

The Model 550502 Evaporation Gauge measures the water level in a standard U.S. Class A evaporation pan (Model 550501) and provides an output proportional to that level. The gauge employs a uniquely balanced sensor assembly to allow high resolution and simple data collection without hook gauge readings and time consuming, frequent visits to the site.

The sensor assembly includes one polypropylene float which rises and falls with the water level in the pan. The movement of the float is transferred to a 5K-ohm potentiometer by means of a rack and gear assembly. The mechanism is designed to eliminate backlash. The output range is 0 to 8 inches, with a measuring accuracy of 1%.

Movement of the float assembly also moves a pointer over an indicating scale for convenient water level checks and comparison to output device readings. The scale is graduated in English units on one side and metric units on the other.

The potentiometer output can be input directly to a data acquisition system. Alternately, it can be input to a signal conditioning module.

Evaporation Pan

It is constructed of low carbon stainless steel and is heliarc welded. The pan is normally installed on a level wooden platform set on the ground.

Specifications

Sensor: Single-float assembly on vertical guide rods.
Transducer: 5K-ohm potentiometer
Range: 0-8"
Resolution: Infinite
Accuracy: 1% (with clean guide rods)
Potentiometer linearity: ±0.5%
Cable: 3 conductor shielded, 50' provided
Weight/shipping: 7.5/10 lbs

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
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MODEL 550502
EVAPORATION GAUGE

OPERATION MANUAL
DOCUMENT 550502-9800

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Model 550502 Evaporation Gauge
Operation Manual

1.0 INTRODUCTION

1.1 Description

The Model 550502 Analog Output Evaporation Gauge was designed to accurately measure the changing water level in an evaporation pan and provide an electrical signal proportional to the water level from which the evaporation rate can be determined. Although it can be used with a wide variety of evaporation systems, it is normally used with a standard Class A, National Weather Service evaporation pan. The gauge consists of a float, pulley, and counterweight attached to a precision 1000 ohm potentiometer, all mounted in a protective enclosure.

1.2 Specifications

Gauge

Electrical Output Range	0-9.73" = 0-5 Vdc
Water Level Range	0-8.0" = 0-4.11 Vdc
Height	27-1/2"
Diameter	8"
Weight	7-1/2 lbs.
Cable	#5883-x (x is length in feet) Specify length when ordering cable.
Connector	3 pin MS-type
Float	5" diameter
Counterweight	4 oz
Water input port	1/" NP coupling, female
Base dimensions	16' triangle with leveling screws
Total resolution	0.0382" with 8-bit converter in datalogger

Potentiometer

Accuracy	1%
Rotation	Continuous
Resistance	1000 ohms, standard
Operating Temperature	-50° to +125°F
Linearity	0.25%
Power	5 Vdc reg

2.0 INSTALLATION

2.1 After carefully unpacking all components, inspect for damage that may have occurred in shipment. Do not discard any packing material until you are certain there is no damage and all items are accounted for, including accessories. In the event of damage during shipment, a claim for loss should be filed with carrier at the receiving location.

2.2 Remove the top cap and remove the float, chain, and counterweight which are packed in the housing for shipping.

2.3 The gauge is connected to the pan by using 1/2" diameter pipe. Flexible tubing is acceptable provided it is not subject to deterioration. The gauge should be placed far enough away from the pan so that it will not cast a shadow on the pan that could have an effect on the evaporation process.

2.4 Level gauge by placing a level on the housing in front of the gear and adjusting the leveling screws on the triangular base until the unit is level.

2.5 After connecting the gauge to the pan and securing all electrical connections, fill evaporation pan with 8" of water and carefully check all joints for leaks.

2.6 The pulley and the potentiometer housing have been marked with indicators that line up when the potentiometer is approximately at the breakpoint between zero and 1000 ohms resistance. To obtain the exact breakpoint for zeroing or base setting, use an ohmmeter across the white and red wires or use the actual readout device that will be used with the unit when in operation.

2.7 The float chain should be placed on the pulley so that the float rests on the top of the water (8" in the evaporation pan) when the pulley is at the breakpoint. For operation, the float chain is placed on the pulley so that a falling level of water will cause clockwise (as seen from the front of the pulley) motion in the pulley and a decrease in resistance in the potentiometer output. Refer to the assembly diagram.

2.8 Carefully secure housing cover into place with allen screws.

3.0 OPERATION

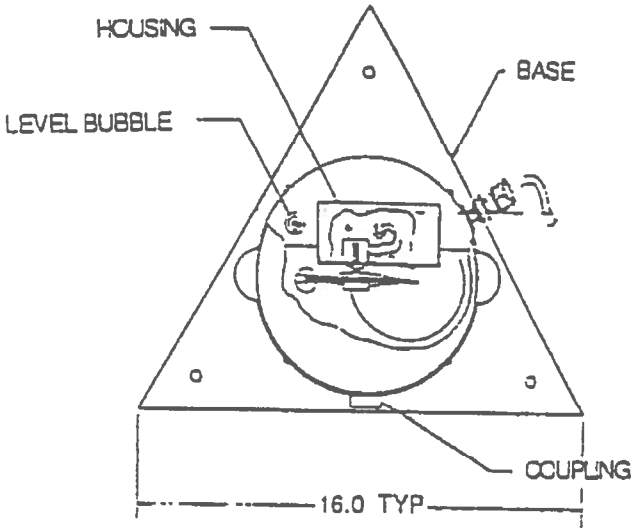
The potentiometer produces a proportional output in relation to the position of the float and can be monitored on site with a datalogger or strip chart recorder.

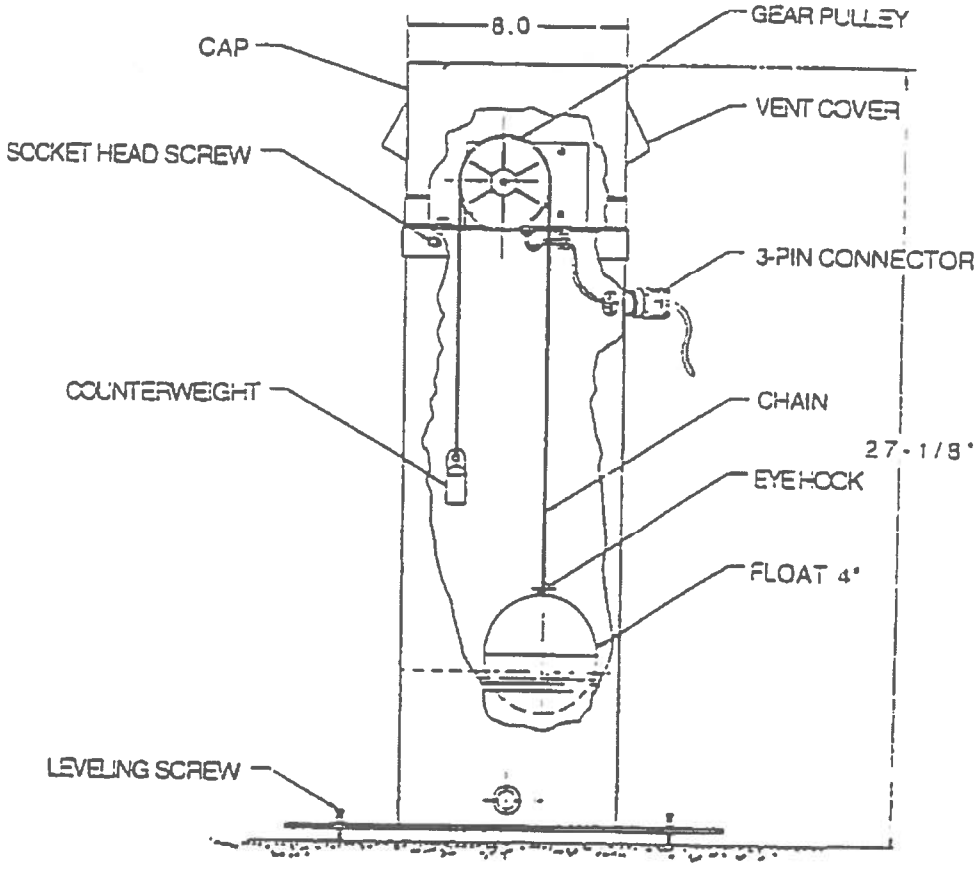
4.0 TROUBLESHOOTING

4.1 Always disconnect the reporting/recording device from power or troubleshoot immediately whenever any of the following conditions are observed: the cable has been damaged, the gauge does not appear to operate normally or exhibits a marked change in performance, the gauge has been dropped or damaged, or it moisture damage has occurred to the circuits.

4.2 If the gauge does not register correctly, first check the connections. Check the potentiometer with a voltmeter. Be sure the reporting/recording device has been powered-up correctly. If the reporting/recording device uses batteries for its primary source of power, check that the batteries have sufficient voltage to power the device.

4.3 Check the sensor cable connections both at the gauge and at the control unit. Cable shorts can cause lack of readings. If a connection is found to be lose, tighten into place and check to see if the problem has been corrected.





500502 EVAPORATION GAUGE ASSEMBLY

WeatherHawk Series 500 Specifications

Weather Station

Temperature Range:	-40 to +122F (-40 to +50C)
Data Storage:	60 days of hourly data
I/O:	Direct connection RS232
	Optional Wireless RF
I/O Data Rate:	9600 baud
Wireless Frequency:	Spread Spectrum 916 MHz
Battery:	Integrated 2.9 AHr Lead-Acid GelCel
Charging Voltage:	16 t0 22 VDC
Current Drain:	10 mA w/o heater
	1.1 A with heater

Sensors

Air Temperature:	Capacitive ceramic
Range	-60 to +140F (-52 to +60 C)
Accuracy:	+/-0.9 F @ -40 to 125 F (+-0.5 C @-40 to 52 C)
Resolution:	0.1 F (0.1 C)
Relative Humidity:	Capacitive thin-film polymer
Range	0-100%
Accuracy:	+/- 3% @ 0-90%RH; +/- 5% @ 90-100%RH
Resolution:	0.1%
Barometric Pressure:	Capacitive Silicon
Range:	17.72-32.48 inHg (60-110 kPa)
Accuracy:	.015 inHg @+32 to +86 F (+-.05 kPa @0-32 C)
Resolution:	.03 inHg @-60 to +140 F (+-.1 kPa @-52 to +60 C)
Solar Radiation:	Silicon pyranometer
Spectral Range	300 to 1100 nm
Reproducibility	+/-2%
Output	.2 mV per W/m^2
Range	0 to 1000 W/m^2
Temp. Range	-40 to 130 F (-40 to +55 C)
Rain:	Piezoelectric
Collecting Area	9.3 in^2 (60 cm^2)
Range	0 to 7.87 in/hr (0 to 200 mm/hr)
Accuracy:	<5% (weather dependant)
Resolution	.001 in (.01 mm)
Wind Direction:	Ultrasonic
Azimuth:	0-360 deg
Response Time:	250 ms
Accuracy:	+- 2 deg
Resolution:	1 deg
Wind Speed:	Ultrasonic
Range:	0-134 mph (0-60 m/s)
Response Time:	.25 s
Accuracy:	+-.67 mph (+- 0.3m/s) or +-2% which ever is greater
Resolution:	.22 mph (0.1 m/s)

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WeatherHawk Series 500

General Description:

The WeatherHawk Series 500 family of weather stations measure and record wind speed and direction, air temperature and relative humidity, barometric pressure, solar radiation, and rain. In addition, the system calculates and exports an evapotranspiration (ET) value that can be used by third party systems for irrigation control. They are designed for applications where a minimal visual impact, high reliability, and a long interval between routine servicing are significant factors in the decision to purchase. The standard Series 500 system incorporates an integral 3 AHr battery pack and can be interfaced with an optional solar panel for high reliability applications.

The Series 500 family is fully compatible with all versions of software, data management, input power and mounting accessories designed for the WeatherHawk Signature Series. It is also backwards compatible with all third party certified software drivers.

The Series 500 WeatherHawk systems utilize solid state sensors, with no moving parts. Solid state sensors enable a low profile design better suited to high visibility locations where a traditional weather station would be visually objectionable; they have higher reliability and a longer interval between routine service and inspection requirements; they are more robust and less susceptible to damage from wind carried debris; and they are not impaired by heavy snowfall or freezing conditions that produce rime ice (NOTE: Heated sensor versions, Models 511/521, must be used in snow or freeze zone applications).

Models 510/511

These versions of the Series 500 weather station are directly connected to a host device (PC or server) through an RS232 serial data I/O located on the bottom of the weather station. The Model 511 incorporates a thermostatically controlled heater element in the sensor head that keeps the ultrasonic wind sensor elements and the piezometric precipitation sensor surface free of snow and ice to −52° C.

Models 520/521

These versions of the Series 500 weather station are wireless to a host device (PC or server) using fully integrated industrial grade 916 MHz spread spectrum RF communications technology. They also have an RS232 serial data I/O located on the bottom of the weather station, which can be used as a second serial communications port, or for programming and testing the system, or for direct data downloads using a PC or PDA. The Model 521 also incorporates a thermostatically controlled heater element in the sensor head that keeps the ultrasonic wind sensor elements and the piezometric precipitation sensor surface free of snow and ice to −52° C. Optional configurations of both units enable replacement of the 916 MHz RF components with 922 MHz and 2.4 GHz RF components to comply with local, regional or national radio frequency licensing requirements.

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Sensor Technologies

Series 500 WeatherHawk weather stations employ the latest in weather measurement sensors. Wind speed and direction use acoustic techniques formerly available on only the most expensive professional wind velocity measurement systems. Rain is measured using an impact surface that literally counts the raindrops and measures their acoustic signature, integrating that information to provide a near real-time value for rainfall amount and rate. Barometric pressure, relative humidity, air temperature and solar radiation measurements are made by calibrated scientific grade sensors typically installed in the finest professional weather measurement and monitoring systems.

Wind Speed & Direction is measured by a sensor consisting of three equally spaced ultrasonic transducers in a horizontal plane. The sensor measures the bi-directional transit time along the three paths established by the transducer array. This transit time is dependent on the wind velocity across the ultrasonic path. For zero wind velocity, both the forward and reverse transit times are identical; with wind, the upwind transit time increases and the downwind time decreases. The values of any two array paths will enable computation of both wind speed and direction, and a signal processing technique enables the measurement to be calculated using the two array paths of the best quality. If the system is used in a high accuracy application a factory revalidation is recommended every five years.

Rainfall is measured with a stainless steel piezometric surface on top of the weather station. As individual raindrops (or hailstones) impact on the surface they each provide an acoustic signature that is measured and processed in real-time to give a value for their volume. The volume is then processed with respect to time to provide a rainfall rate. This measurement technique eliminates all of the traditional problems with tipping bucket type rainfall measurement devices, including worn or damaged bearings, clogged funnels and drip orifices, and damage from wind blown debris.

Air temperature and relative humidity (RH) sensors are combined in an integrated, user replaceable unit that requires no calibration. The RH sensor is a thin polymer, capacitive type sensor that degrades with exposure due to age and airborne contaminates. It should be user replaced every three years to maintain accuracy, and at a shorter interval if the location is subject to high levels of air pollution or is subject to airborne chemical spraying. The air temperature sensor is a capacitive ceramic sensor that is typically not subject to environmental degradation.

Barometric pressure is measured with a capacitive silicon temperature corrected strain gauge device that is typically not degraded by environmental exposure and does not require calibration after manufacture.

Solar Radiation is measured by a silicon pyranometer with a cut filter limiting the spectral exposure to the 300-1100 nm wavelength. This device typically degrades at a rate of 2% of the full scale value each year and should be recalibrated, or replaced every 3-5 years, depending on the application.

Data Transfer Protocols, Software and Data Interface Hardware

All WeatherHawk systems communicate using a proprietary Pakbus protocol. Any qualified software developer may request a software development kit, at no charge, to assist in the development of software drivers for third party devices or software.

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Software

WeatherHawk offers the following software applications for weather station management, data acquisition and logging, report generation and data display.

- *Visual Weather Station* – a single host, multi-site professional application that will communicate with any WeatherHawk weather station, as well as CR200 Series data loggers from Campbell Scientific, Inc. Visual Weather Station adapts to any data telemetry scheme including direct connection, wireless short haul RF (spread spectrum radio), wireless long-haul RF (VHF/UHF radio), satellite modem, IP modem/server module, or landline and cellular modems. The application also offers a variety of standard and user defined reports and export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP computers.
- *WeatherHawk-XP/X* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. WeatherHawk-XP/X connects using a directly to the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum radio), or IP modem/server module, or landline and cellular modems. The application also offers a three export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP and Macintosh OS-X computers. This software application will also interface with the NOAA/NWS CAMEO application for First Responder applications requiring plume modeling.
- *Virtual Weather Station* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. Virtual Weather Station connects directly through the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum radio). The application also offers a two export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on IBM compatible computers.
- *LoggerNet* – a single host, multi-site professional application that will communicate with any WeatherHawk weather station, as well as any data loggers from Campbell Scientific, Inc. LoggerNet adapts to any data telemetry scheme including direct connection, wireless short haul RF (spread spectrum radio), wireless long-haul RF (VHF/UHF radio), satellite modem, IP modem/server module, or landline and cellular modems. The application also offers a variety of standard and user defined reports and export file formats, and with the RTMC module it will support the generation, export and update of a weather data GUI for a website. This application runs on IBM compatible computers.
- *PConnect* – a single host, single site professional application that will communicate with any WeatherHawk weather station, as well as a range of Campbell Scientific data loggers. PConnect is used for direct download and storage of data through the serial port on either the weather station or its companion RF4xx receiver (if wireless). The software is typically utilized for field data acquisition with later export to a PC for post-processing, display and long-term archiving. It also enables on-site reprogramming of the weather station by uploading pre-configured program files. It is not designed for long haul or automated data collection protocols. This application runs on a range of PDA devices, check with Campbell Scientific, or WeatherHawk for a list of compatible units.

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- *Weather Display* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. Weather Display connects directly through to the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum), or IP modem/server module. The application also offers a range of export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP computers.

Data Interface Hardware

Weatherproof serial cables are available in 25, 50 and 75 foot lengths for permanent direct connection to the RS232 I/O on any WeatherHawk weather station. These cables feature nickel plated brass DB-9 connectors for corrosion resistance and have a Sanoprene jacket which is suitable for both high UV and direct burial environments.

An *RF4xx spread spectrum RF transceiver* is supplied as standard equipment with every wireless WeatherHawk weather station. The unit comes with an AC power supply (120 VAC/60 Hz), a 6 foot serial cable and an antenna. Additional RF4xx kits can be purchased for simultaneous communication with any WeatherHawk wireless weather station, enabling multiple host computers to use the data from a single weather station. Typical applications for multiple receiver units are in home automation where a single weather station may support a whole house control unit, with touch panel data display units; and a discrete PC, which may act as the server for a local intranet or internet weather data display website.

WeatherHawk IP server modules are a proprietary web server that is designed to interface the serial output of any WeatherHawk weather station, or companion RF4xx transceiver with an Ethernet. Output formats from the IP server module are HTML, XML and CSV (with headers).

Mounting Systems

All WeatherHawk weather stations will interface with the full range of mounting systems supplied by WeatherHawk. They consist of:

TP-1 Tripod – The tripod, with its range of accessories is the most rugged and adaptive weather station mounting system. It supports both rooftop (sloped and flat) and ground mounts, with mast heights to 10 feet. Accessories consist of a weather station alignment kit (optional), ground stakes (optional), a rooftop sealing kit (standard), grounding rod kit (optional), mast length extensions (optional), and a guy-wire kit (optional).

HM Series – The HM Series house mount kits are adapted satellite dish mounts that will support attachment to sloped and flat roofs, and to the vertical facia and reinforced trim boards around the roofline of a home. The accessories consist of mast extensions, a Retro-deck base assembly that offers additional stability and support on composite roof coverings; and a Comm-deck mount that offers a weatherproof penetration through a roof for a directly connected weather station.

Various additional specialized mounting tripods are available for high environmental abuse environments, or quick deployment temporary applications.