Relative Humidity Sensor

083D

The Model 083D 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.

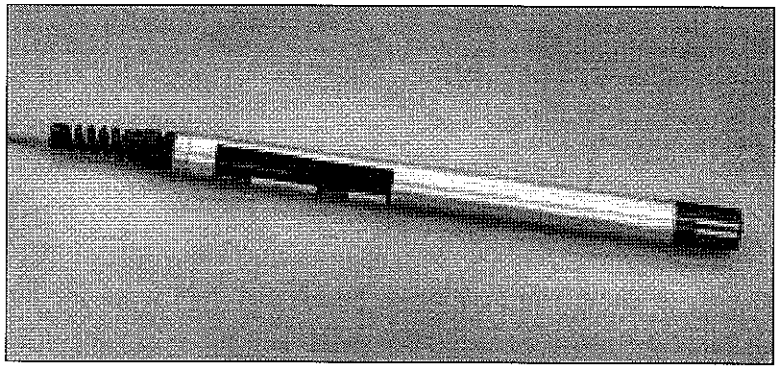
Features

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

The sensor responds to the full range from 0-100% relative humidity. Its response is essentially linear, with small hysteresis, and negligible temperature dependence.

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 form 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 20°C 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:	.75 in (19 mm) diameter 7.5 in (190.5 mm) length
Weight:	2.5 oz (70.9 g)

Met One Instruments, Inc.

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Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Tel (972) 412-4747, Fax (972) 412-4716
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Ordering Information

083D - X - Y

- 0	Temperature Sensor not included
- 1	-50°C to +50°C, 060A type (see 060A Data Sheet) Temperature Sensor included

- X -

- 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 or Model 5980 Radiation Shield
- 6	With 6" Signal Cable for direct use with Model 076B Motor Aspirated Radiation Shield or Model 077 Low Power DC Motor Aspirated Shield

MODEL 083D
RELATIVE HUMIDITY/TEMPERATURE SENSOR

OPERATION MANUAL

Met One
Instruments

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083D RELATIVE HUMIDITY/TEMPERATURE SENSOR OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 The 083D Sensor is 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 083D Sensor model number describes the sensor options as follows:

083D - A - B

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 -XX (XX = cable length in feet)
-6	076	2144 -XX
-6	077	2408 -XX
-35	073B	2348 -XX
-35	075B	2348 -XX
-35	5980	2348 -XX

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 083D-X-6 sensor mounts in either a 076B Radiation Shield, with a 2144-XX signal cable or a 077 Radiation Shield with a 2408-XX signal cable.
The 083D-X-35 mounts in a 073B, 075B, or 5980 Radiation Shield with a 2348-XX signal cable.

Table 1.1
Model 083D Relative Humidity Sensor Specifications

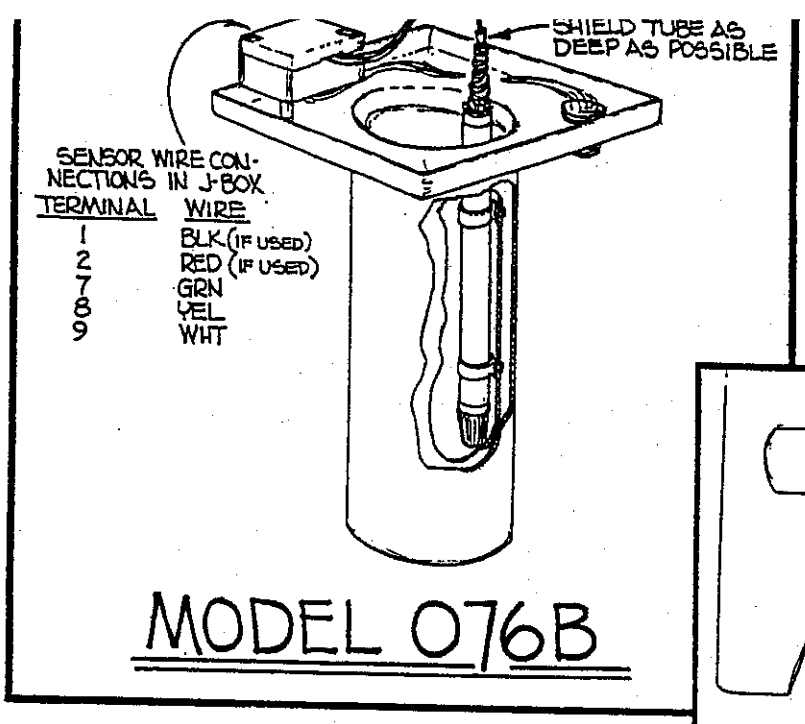
Sensing Element	Thin-film capacitor
Range	0-100% RH
Temperature Range	-20°C to +60°C
Response Time	15 seconds at 20°C 90% of final RH value
Accuracy	Better than ±2% RH between 10% RH and 100% RH
Hysteresis	For 0% to 100% to 0% excursion less than ± 1%
Temperature Coefficient	±0.04% per 1°C
Output	0 - 1V full scale (standard)
Input Power	12V DC ± 2V, 12 ma

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

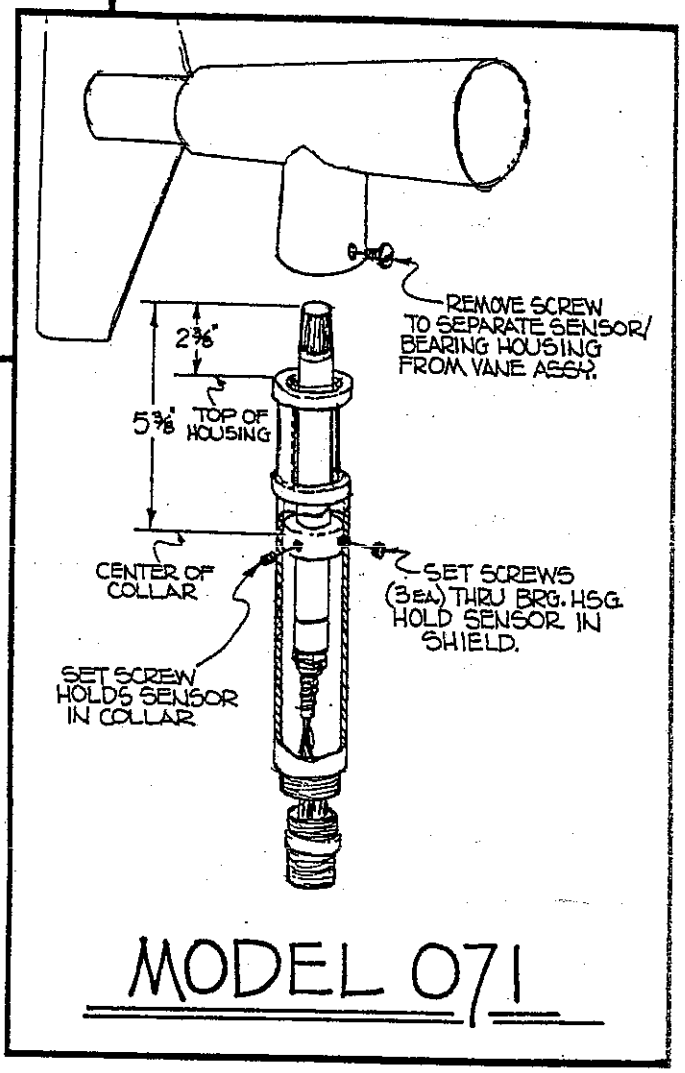
Range	-50° to +50°C (standard range)
	Accuracy ±0.10°C
Time Constant	10 sec.

2.0 INSTALLATION

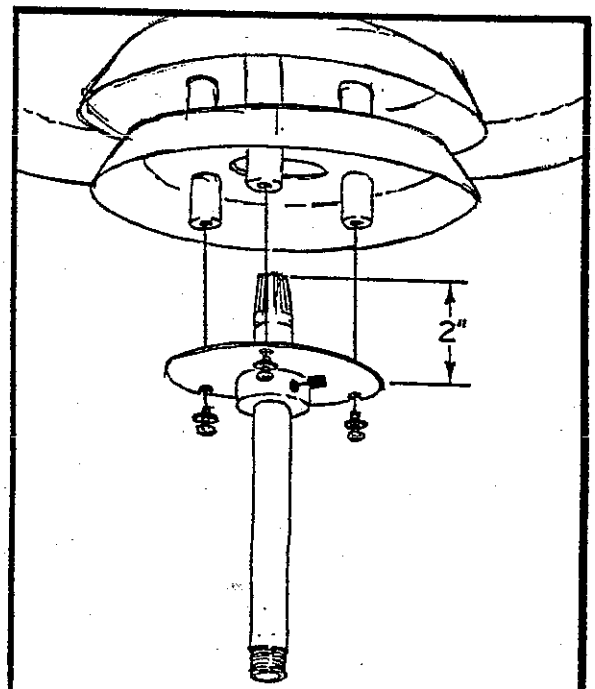
2.1 If sensor comes mounted in a radiation shield, refer to radiation shield manual section for mounting details. Sensors not furnished in a radiation shield should be mounted in a representative location having good air flow and shaded from sunlight or other heat radiation sources that would affect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



MODEL 076B



MODEL 071



MODEL 073B

TYPICAL 083D 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 4.2.

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 adverse to average 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 the sensor element if you do not know the correct procedure.*

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.

4.3 Sensor Element 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. 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. The safest way is always to use distilled water. However, if the dirt can not be washed out with the water, you can use also isopropanol. In that case the instructions are:
-rinse the sensor in isopropanol during 1min (immersed, move it every now and then)
-rinse the sensor in water during 15min (can be left immersed in water)
-let the sensor dry

3. 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-plug the old sensor element and plug a new one in its place. The sensor chip is very delicate, so observe the following precautions. DO NOT TOUCH THE SENSOR ELEMENT WITH BARE HANDS. Handle the sensor element only gripping the nylon edge. Do not bump the sensor element when reinstalling the protective grid.

4. After replacement of the sensor element, the humdity probe must be recalibrated.

SPARE PARTS:	820202	ELEMENT
	560014	FILTER, MEMBRANE
	560015	FILTER, BRONZE

4.4 Relative humidity Calibrator model 3226

It is essential that the functioning of an instrument is checked against a reference from time to time. Humidity Calibrator Model 3226 is used to make calibration and spot checking of humidity probes and transmitters easy and reliable.

The operating principle of the 3226 is based on the fact that a saturated salt solution generates a certain relative humidity in the air above it. The reading of the humdity probe or transmitter can then be adjusted accordingly. This is a generally accepted and reliable method for calibrating humidity instruments - many leading laboratories use this method. Usually two or three different salt solutions are used which are chosen according to the application.

The structure of the 3226 is designed to ensure fast and stable temperature equilibration. No external power is required. In addition to laboratory use it is also suitable for one-site checks. Special transit covers make the 3226 particularly simple to transport. These features together with the pre-measured salts with a long lifespan (even after taken into use) make the 3226 the ideal choice for the most demanding user.

The calibrator is provided with certified salts. A sample calibration is made from each batch in the Measurement Standards Laboratory (MSL). The uncertainities achieved using these salts at e.g.+20 ° C are given here:

- LiCl salt, 11%RH (± 1.3%RH)
- NaCl salt, 75%RH (±1.5%RH)

3226 includes a thermometer which is used for measuring the temperature during the calibration and can also be used for checking temperature measurement accuracy of the transmitter. The accuracy of the thermometer is ±0.3°C. Each thermometer has been calibrated.

4.5 Humidity Probe Calibration using 3226

1. 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 11% and the latter approximately 75% 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.

2. 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 to fresh

The calibration bottles can be used for up to one year without changing to 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	11.3	11.3	11.3	11.3	11.3	11.3	11.2

SODIUM CHLORIDE

Ambient Temperature °C	10	15	20	25	30	35	40
Calibration Value % RH	75.7	75.6	75.5	75.3	75.1	74.9	74.7

A. 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.

B. CALIBRATION FOR HIGH HUMIDITY (76%)

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

C. Repeat steps A and B until no further adjustments are required.

TABLE 4.2

Sensor Model 083-1-x

Tc °C	Rt kΩ	Tc °C	Rt KΩ	Tc °C	Rt kΩ
-50	158.181	-14	47.173	19	21.908
-49	150.561	-13	45.997	20	21.423
-48	143.555	-12	44.861	21	20.949
-47	137.093	-11	43.761	22	20.484
-46	131.114	-10	42.696	23	20.029
-45	125.564	- 9	41.665	24	19.583
-44	120.400	- 8	40.665	25	19.147
-43	115.583	- 7	39.696	26	18.719
-42	111.079	- 6	38.755	27	18.300
-41	106.858	- 5	37.843	28	17.899
-40	102.895	- 4	36.957	29	17.147
-39	99.166	- 3	36.097	30	17.092
-38	95.651	- 2	35.260	31	16.705
-37	92.333	- 1	34.447	32	16.325
-36	89.196	0	33.657	33	15.952
-35	86.224	1	32.888	34	15.586
-34	83.406	2	32.139	35	15.227
-33	80.729	3	31.410	36	14.875
-32	78.183	4	30.700	37	14.529
-31	75.760	5	30.009	38	14.190
-30	73.449	6	29.335	39	13.856
-29	71.245	7	28.677	40	13.528
-28	69.138	8	28.037	41	13.206
-27	67.124	9	27.411	42	12.890
-26	65.195	10	26.801	43	12.579
-22	58.242	11	26.206	44	12.274
-21	56.671	12	25.624	45	11.974
-20	55.160	13	25.056	46	11.678
-19	53.705	14	24.501	47	11.388
-18	52.303	15	23.959	48	11.102
-17	50.952	16	23.429	49	10.822
-16	49.648	17	22.911	50	10.545
-15	48.389	18	22.404		

Sensor Range = -50 to +50°C (-58 to +122°F)

Conversion Formulas:

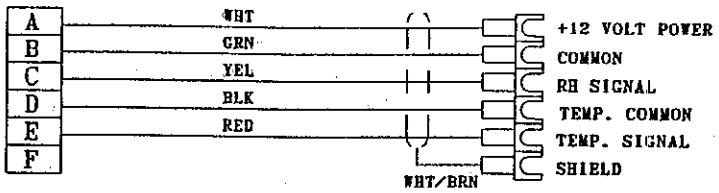
$Tc = (((Rt^{-1})+(23100^{-1}))^{-1} - 13698.3)/ - 129.163$

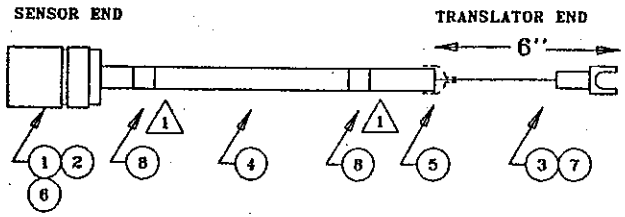
$Rt = ((((-129.163Tc)+13698.3)^{-1}) - 23100^{-1})^{-1}$

Where: Tc= Temperature in °C

Rt = Sensor Resistance in Ohms (Ω)

REVISIONS			
REV	DESCRIPTION	DATE	APP
C	REDRAWN PER E.O. 1131	9/11/91	DI





SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500391	CONNECTOR, 6 PIN, FEMALE	1
2	480508	CLAMP	1
3	600193	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	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

Send rate 9600

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.
		1873
SCALE		SHEET 1 OF

REVISIONS			
REV	DESCRIPTION	DATE	APPR
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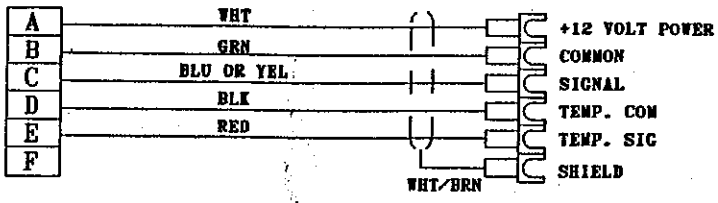
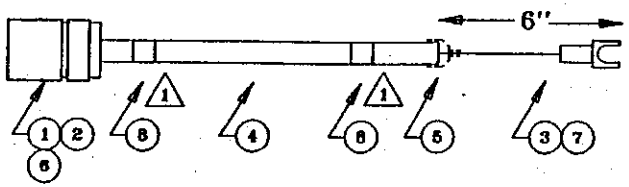
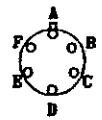
B	EO 1191	6/5/92	DH



SENSOR END TRANSLATOR END





SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500351	CONNECTOR, 6 PIN, FEMALE	1
2	460500	CLAMP	1
3	600193	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	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, RELATIVE HUMIDITY AND TEMPERATURE

SIZE | FSCM NO. | DWG NO. 2348

SCALE | SHEET 1 OF

REVISIONS			
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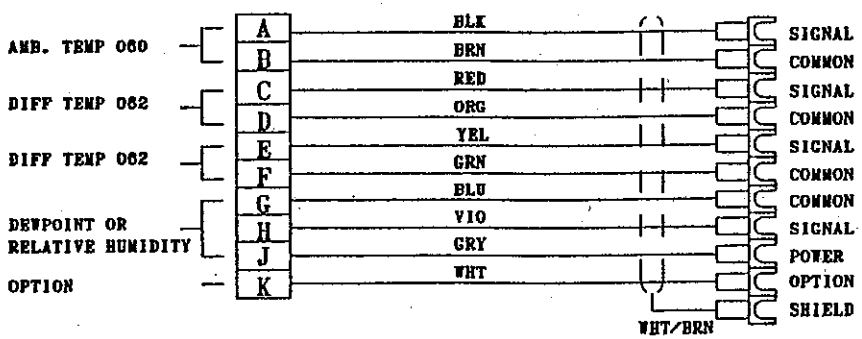

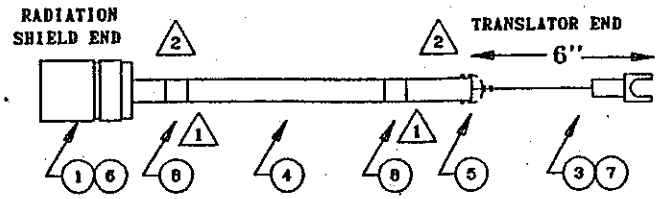

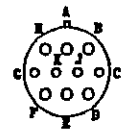

SOLDER CUP VIEW

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 | FSCM NO. | DWG NO. 2144

SCALE | SHEET 1 OF

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