

**APPENDIX F. MONITORING THE ENVIRONMENT IN SPACES HOUSING MUSEUM
PROPERTY**

A. INSTRUCTIONS FOR CALIBRATING A HYGROTHERMOGRAPH

In order for the hygrothermograph to be accurate, and records based on its readings to be of value in interpreting the data, this instrument should be calibrated at least quarterly and preferably monthly. The calibration process involves checking instrument readings against known relative humidity and/or temperature levels and making adjustments as necessary. **NOTE:** Temperature rarely goes out of calibration, because the temperature-reading bimetal element on the instrument is very stable. Use a portable thermohygrometer to calibrate each hygrothermograph. (If experienced personnel are available, a sling or aspirating psychrometer may be used.) Once the relative humidity and temperature levels are determined, adjust the hygrothermograph to match the known conditions.

1. Using the Hygrothermograph Calibration Record

Use the "Hygrothermograph Calibration Record" illustrated in Figure F.1. The instructions for using this record are as follows:

- a. On the first line, record the brand and model of the hygrothermograph being calibrated. Record the serial number and the property number on the second line. Recording this information facilitates comparing test records for a single instrument over a period of years.
- b. On the third line, record information about the thermohygrometer being used to calibrate the hygrothermograph. Record the serial number and the property number on the fourth line.
- c. During the calibration, both the hygrothermograph and the thermohygrometer should be in the same immediate vicinity. Record this location as specifically as possible on line five.
- d. On the sixth line, record the name and title of the person who is conducting the calibration tests.

Insofar as possible, the same person should conduct all tests on a single hygrothermograph.

2. Calibrating the Hygrothermograph

Hygrothermographs may be calibrated by following these steps:

- a. Read and follow any suggestions made by the manufacturer concerning calibration of the instrument.
- b. At a selected time, record the information requested on the chart: date, time of day, relative humidity reading from the hygrothermograph, and temperature reading from the hygrothermograph.
- c. Immediately after recording readings obtained from the hygrothermograph, operate the thermohygrometer at the same location and in accordance with the manufacturer's instructions. Record the relative humidity and temperature readings indicated by the thermohygrometer in the spaces provided on the record.
- d. Adjust the hygrothermograph to match thermohygrometer readings. Follow the instructions for making adjustments provided by the instrument's manufacturer. If the average differences are found to be greater than 1% relative humidity or 1° temperature, adjust the hygrothermograph up or down by amounts equal to the average differences. For example, if the hygrothermograph is recording high by a factor of 6%, adjust the recording arm so that it reads about 6% lower. Likewise, if the hygrothermograph is recording temperature low by a factor of 4°, adjust the recording arm so that it reads about 4° higher.
- e. If there are differences between the two relative humidity readings and/or the two temperature readings, record them in the appropriate spaces. For example, if the relative humidity reading on the hygrothermograph was 48% and the reading from the

thermohygrometer was 45%, record the difference between them as "hygro. high by 3%." Always record differences in terms of whether the hygrothermograph reading is higher or lower than the thermohygrometer reading because it is the hygrothermograph that is being calibrated. If there is no difference between

two readings, simply enter "0 difference" in the space.

- f. Wait for 15 minutes, then repeat steps c and d. Repeating Step c is necessary, because the instrument's linkages often require time to equalize. If applicable, adjust the instrument again.
- g. If significant differences (over 5%) still exist after a third check, refer to the instruction manual for the hygrothermograph to determine why the instrument might be malfunctioning. Relative humidity readings most often are erroneous because of a broken or dirty hair element. Temperature readings can be in error because of dust or other fouling of the bimetallic strip. Read and follow the manufacturer's instructions for cleaning, maintaining, and repairing the hygrothermograph.
- h. After the calibration has been completed and the hygrothermograph has been adjusted properly, file the calibration record form with the charts from the hygrothermograph. It is important that the forms be kept so that they can be compared in the future to other calibration records on the same instrument in order to determine if there is a pattern of incorrect readings. If it is determined every time that it is calibrated that a hygrothermograph consistently has been giving incorrect readings, consider returning it to its manufacturer for repairs.

HYGROTHERMOGRAPH CALIBRATION RECORD

Hygrothermograph: Brand _____ Model _____
Serial No. _____ Property No. _____
Psychrometer: Brand _____ Type _____ Model _____
Serial No. _____ Property No. _____
Location of Hygrothermograph: _____
Name and Title of Person: _____

		RELATIVE HUMIDITY READINGS			TEMPERATURE READINGS		
DATE	TIME	HYGRO.	PSYCH.	+% DIFF.	HYGRO.	PSYCH.	+% DIFF.

Figure F.1. Hygrothermograph Calibration Record

B. ORGANIZING DATA FROM HYGROTHERMOGRAPH CHARTS

It is essential to organize the data recorded by each hygrothermograph. The hygrothermograph charts are important documents. At the end of each recording period (e.g., 7 days, 31 days), take time to examine all charts and to organize data. Use the "Museum Environmental Monitoring Record" in Figure F.2. to organize the data. Instructions for the use of this form are as follows:

1. Column 1. Record the current date consistently for example "01/JUN/88" or "06/01/88" for June 1, 1988.
2. Column 2. Record the time of day, using the 24-hour clock. Thus, 8:15 a.m. would be "0815" and 3:45 p.m. would be "1545".
3. Columns 3a and 3b. Records of exterior conditions should be made at least once a day. Data should be taken from the unit's weather station if there is one; otherwise that information can be obtained from the National Weather Service (NWS), from the local newspaper, or from a local radio or television station, depending upon which one provides the most accurate data. Be aware that weather conditions around the museum can be somewhat different than conditions around the local weather station.
4. Columns 4a and 4b. Record how the museum's thermostat and humidistat are set. If the building is served by more than one climate control or HVAC system, there may be more than one set of control instruments. In that case, it will be necessary to complete one Monitoring Record form for each climate control system. Remember, the purpose of completing the form is to determine how interior conditions vary, if any, from how the climate controls are set and to determine the extent to which those conditions are influenced by exterior weather conditions.
5. Columns 5a and 5b. Records of interior conditions should be taken from an accurate thermohygrometer or recording hygrothermograph. They can be read daily from a

hygrothermograph chart, but it generally will be easier to record the information the following week after the chart has been removed. If more than one monitoring instrument is being used, the unit has two choices:

- a. Keep a separate Monitoring Record form for each instrument. This alternative should be chosen if the instruments typically reflect different conditions in different parts of the spaces housing museum property. Of course, this alternative also will be chosen if the such spaces have more than one climate control system because the space controlled by each system will be separately monitored.
 - b. Average the readings from the different instruments and record the average on the monitoring record. This alternative may be chosen if the range between the high and the low readings on the different instruments does not exceed 5% relative humidity or 5°F temperature.
6. Column 6. Unusual weather conditions should be recorded whenever they are influencing interior conditions. For example, if it has been raining all day, that fact should be recorded because it might help explain a rise in relative humidity. In addition be sure to note such events as: loss of electricity or fuel; breakdowns of mechanical equipment; occasions when outside doors have been kept open for extended periods, such as during maintenance activities; discharges of water sprinkler systems; water leaks or flooding inside the building; and any other events that might cause changes in normal interior climatic conditions. Also note whenever visitation has been exceptionally heavy or exceptionally light. The presence or absence of visitors (and staff) often can markedly effect interior climatic conditions.

ENVIRONMENTAL MONITORING RECORD								
Col. 1	Col. 2	Col. 3		Col. 4		Col. 5		Col. 6
		EXTERNAL		CONTROLS		INTERNAL		REMARKS
DATE	TIME	TEMP	RH	TEMP	RH	TEMP	RH	

Figure F.2. Environmental Monitoring Record

C. INSTRUCTIONS FOR USING THE LIGHT AND HEAT MEASUREMENT CHART

In developing a monitoring plan for spaces housing museum property, the following light and heat measurement chart will be useful in recording and reviewing collected data. The recorded information should be reviewed on a monthly basis and corrective measures taken as needed.

1. Identify the unit and the structure in the appropriate blocks.
2. Enter the day, month, and year; and enter the time of day in the appropriate blocks.
3. Location Block: Building floor plans should be used in conjunction with the Light and Heat Measurement Record" in Figure F.3. Specific light measurement sites should be identified on the floor plan with a number. A typical entry in the location column should identify the room and the measurement site.
4. UV Block: Direct readings of ultraviolet radiation can be taken with the "Crawford" UV meter. If the reading is above 75 microwatts per lumen (uW per Lumen), corrective action is needed. Measure both visible and ultraviolet light at each site.
5. Lux Block: Using a visible light meter, record the intensity of visible light in lux (lumens per square meter). If the meter reads in foot-candles (lumens per square foot), convert foot-candles to lux by multiplying by 10 (1 foot-candle = 10.76 lux).

The accepted standard for museum collections is 50 to 300 lux (5 to 20 foot-candles) depending on the materials which comprise the collection. With the exception of materials that are insensitive to high light levels, corrective measures should be initiated when the recommended lux level is exceeded.

6. °C Room Block: Enter the air temperature (°F) for the particular location using an accurate thermometer or by noting temperature readings on the chart of a recording hygrothermograph.

7. °C Object Block: Enter the surface temperature of objects. Use an ordinary thermometer held near, but not on, the surface of an object that is exposed to direct sunlight or locally illuminated by artificial lighting fixtures, or use a meter especially designed to read the surface temperature of objects. Consider exhibit case environments and objects situated near heating and ventilation ducts as well as objects located on exterior walls. This measure aids in the identification of localized heating or potential condensation sites.

8. Light Source, Weather, and Comments Block: Record information concerning the quality and the source of illumination, corrective measures, and weather conditions (overcast, rain, sunny). Any corrective actions or unusual circumstances should also be recorded here.

LIGHT AND HEAT MEASUREMENT RECORD

UNIT: _____ STRUCTURE: _____

Date	Time	Location	UV Reading	LUX Reading	Room Temperature	Temperature Near Object
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						
Light Source, Weather & Comments:						

Figure F.3. Light and Heat Measurement Record

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