Homeland Security

Science and Technology

TechNote

Temperature and Humidity Monitors/Recorders

Hospital staff, EMTs, laboratories, and other entities with a role in responding to emergencies need to store and transport certain materials such as blood, pharmaceuticals, and tissue samples under carefully controlled conditions to maintain viability. Fluctuations in temperature and humidity must be monitored in order to determine if necessary materials have been compromised during storage and distribution. Medical supplies and vaccines that have been improperly stored will not effectively prevent or treat diseases during response to an incident. Temperature and humidity monitors enable users to gather, store, and track this data accurately and quickly.

How They Work

A temperature and humidity monitor consists of a sensor, a method of recording the sensor data, and a means of alerting outside personnel when values fall outside acceptable ranges.

Several different sensor types are commonly used to measure temperature:

- Thermometers use the thermal expansion of a medium, which can then be measured by a change in length or pressure.
- Thermocouples use two wires fabricated from dissimilar materials, which will produce a current proportional to the temperature being sensed.
- Resistance temperature measuring devices measure changes in temperature based on changes in resistance of the sensor element exposed to the temperature. Sensor elements are generally made of metal or semiconductor material (also called thermistors).

Humidity monitors also use a variety of different sensors:

- Bulk polymer resistive sensors, which have the advantages of being interchangeable, usable for remote locations, and inexpensive.
- Capacitive sensors, which can be used under wide relative humidity ranges and are tolerant to condensation.
- Thermal conductivity sensors, which perform well in corrosive environments and at high temperatures.

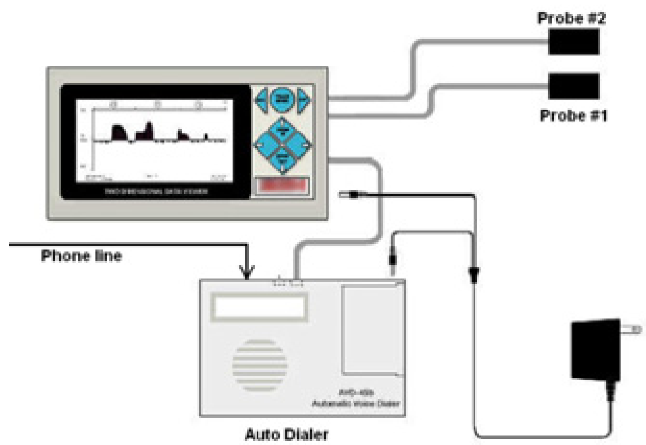

Figure 1. Schematic of Temperature/Humidity Monitor

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology (S&T) Directorate of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Features

Most temperature and humidity monitors collect and store the necessary data. Features that make one monitor more suitable than another for specific applications include:

- Temperature Range: Usually -30°C to 80°C (Thermocouple extends range from -200°C to 1,250°C).
- Relative Humidity Range: Usually 5 to 100 percent, sometimes down to 2 percent.
- Fixed or Portable: Portable may have either an internal or external sensor.
- Single or Multi-Use: Single-Use prevalidated monitors can be effectively used during transport.
- Power Supply: Alternating Current (AC) with battery backup. Many can operate up to 40 hours with 9-volt batteries. Portable models use lithium batteries, which can operate up to 4 years.
- Data Logging: Options include the frequency of data collection, length of data storage (6 months to years), and data averaging.
- Data Display: LCD, chart paper, or computer monitor.
- Data Transfer: RS232 cable, USB cable, print to paper chart, or wireless.
- Alarm: Flashing light, siren, and/or telephone, e-mail, or pager notification.
- Alarm Settings: Alarms on both high and low temperatures and humidities; alarm delayed during opening of doors.

Applications

Temperature and humidity monitors are used by the medical, scientific, and emergency response fields. Vaccines and medications must be stored at the correct temperature to remain effective and prevent the onset of disease in exposed individuals. Temperature monitoring and data collection allows doctors and hospitals to be compliant with the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), ensuring that vaccines are stored properly and patients are getting the proper dosages. Blood products are a valuable commodity, especially during a response to a catastrophic incident. Organizations involved in medical supply and management must ensure that blood products and pharmaceuticals have been maintained at the proper temperature during distribution to temporary treatment locations. Blood plasma is normally stored at -30°C. If a freezer begins to warm up, authorities must take action to prevent the plasma from thawing.

Figure 2. Refrigerator with Monitor

Laboratory testing is used to assess population exposures to chemical, radiological, and biological agents. This testing frequently requires samples to be stored under defined temperature and humidity conditions for the tests to be valid.

The sensitivity of chemical warfare agent detectors varies with operating conditions, including temperature and humidity. The conditions at sampling must be known accurately in order to properly interpret the results from these detectors.

Different types of monitors are available to meet varying needs. Storage and distribution centers may be satisfied with fixed monitors that download data to a computer. Portable monitors that can transmit data wirelessly would be useful for the transport of environmentally sensitive pharmaceuticals.

Figure 3. Wireless Data Logger

References

American National Standards Institute (ANSI) F2362-03, (Reapproved 2009). Standard Specifications for Temperature Monitoring Equipment.

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Handbook of Temperature Measurement: Temperature and Humidity Measurement, by Robert E. Bentley, Springer-Verlag, 1998.