VAISALA / APPLICATION NOTE

5 Frequently Asked Questions about Temperature and Humidity Validation/Mapping

How you answer these key questions should be scientifically based, appropriate to your facility and product, and suitable for the space being mapped.

1. What limits should I use as an acceptable range for my study?
2. What type of sensor(s) should I use?
3. How many sensors do I need, and where should I place them?
4. What kind of calibration do my sensors require?
5. What is the appropriate duration for a mapping study?

The U.S. Food and Drug Administration's (FDA) regulations tell us that we must identify the environmental conditions that can affect the strength, identity, safety, quality, and purity of our regulated products, whether they are pharmaceuticals, medical devices, or biologic products. The FDA regulations also say we must be able to demonstrate that we have maintained our product storage spaces such that the required storage conditions for our products have been met. To meet these requirements for temperature or humidity, the common industry practice is to perform a mapping validation, usually in conjunction with an installation qualification and operational qualification of the equipment involved (e.g., incubator, refrigerator, freezer, stability chamber, cold room, or warehouse).

Many validation contractors have the equipment and expertise to perform a mapping validation at a competitive cost. If you don't have validation expertise in house, contracting might be a smart choice for your company. However, mapping validations are among the simplest of validation exercises, and therefore represent a fairly simple task to bring in-house as you build validation competency within your organization. Some contractors will happily prepare the protocol for you and rent the equipment so that you can learn this skill one step at a time.

Most people who contemplate doing a mapping validation for the first time look for answers to these five questions that are answered in this application note.

What limits should I use as an acceptable range for my study?

This depends on what you are storing. You should be able to use the results of your stability studies, or the recommended storage conditions from the manufacturer of the product you are storing. You can use tighter limits if you wish, but it will be hard to justify using limits that are wider.

What kind of sensors should I use?

Your sensors should measure the attribute of concern—e.g., temperature and humidity. They should be accurate: An error of ±0.2°C is good for temperature, and ±3 percent is good for relative humidity. You can use thermocouples or data loggers, available from a wide variety of suppliers. If you use devices that require software to collect and download the data, or to generate reports, you will need to show that the software has been validated and is compliant to 21 CFR Part 11. Buy, rent, or borrow what you need.

How many sensors do I need?

The International Society for Pharmaceutical Engineering (ISPE) provided some guidance in its document, "ISPE Good Practice Guide: Cold Chain Management" published May 2011.

For spaces less than 2 m^3 in volume, nine sensors are recommended. These would be placed in each corner, with one in the geometric center of the space. This would be a good configuration for most refrigerators, freezers, and incubators. For spaces between 2 m^3 and 20 m^3 in volume, 15 sensors are recommended. The configuration is the same as the nine sensor configuration, but the six additional sensors are placed in the geometric center of the plane of each wall, ceiling, and floor. All sensors, other than the one in the center, should be placed away from the nearest wall at a distance that will define the actual volume of the space used for storage.

An additional sensor should be placed adjacent to the display, control, and monitoring probe(s), if applicable. And always, if you have more sensors, you might as well use them. However, be careful about collecting too much data; as that creates extra work and sets a precedent for future studies.

If you are mapping spaces with volumes larger than 20 m^3, there is no easy guideline. You must assess the space and determine likely sources of variation in temperature and humidity, such as HVAC systems, doors, and windows. Include these observations in your rationale so that the reviewers of the test documents can understand and evaluate your choices.

A great approach to these larger spaces is to limit the sensor placement to only the spaces where product is actually stored, such as the racks and shelves. This can save on the number of sensors required and greatly simplify the process of determining sensor placement. However, if you map only the racks and shelves, the area will require procedural controls to ensure that product is stored only in the areas that were mapped.

What kind of calibration do my sensors require?

Sensors must be shown to be in calibration prior to the study, and the calibration must be verified following the study. If you have calibration capabilities at your facility, you can do the calibrations and verifications in-house. NIST traceability is expected. If you have purchased or rented sensors, you can likely depend on the vendor to supply initial calibration services.

What is the appropriate duration for a mapping study?

Your mapping study should be long enough to provide confidence that you have accurately captured the environmental dynamics of the space being mapped. Forty-eight hours is sufficient for most small spaces under 2 m^3. This is assuming the space is not actively in use. The larger the space, and the more actively it is used during the study, the longer the expected duration of mapping. For a warehouse in use five days a week, a study duration of one week may be appropriate. You might want to consider seasonal changes as well for these spaces, performing your mapping studies twice—once each during the hottest and coldest times of the year.

For all of these questions, it's important that you develop a clear rationale for your choices and document them in your validation protocol. Your rationale should be scientifically based, appropriate to your facility and product, and suitable for the intended use of the space being mapped.

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