

RAPID RH[®] 5.0

BEST PRACTICES



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Abstract

Wagner Meters has developed a reusable line of relative humidity (RH) sensors for use in concrete, compliant with the ASTM F2170 standard. This sensor system is employs many of the features of the Rapid RH® L6 line of permanently embedded sensors. There are certain practices that should be performed with this sensor system that do not naturally apply to the L6 version. This document helps to identify those and expand on the reasoning behind them.

Introduction

The Rapid RH 5.0 reusable sensor system lends itself well to the F2170's demanding requirements of compliant testing. Some of these demands are not relevant to the current permanently embedded L6 sensors; as such, we want to help educate our customers on the best ways to use the 5.0 reusable sensors and the methods to employ for obtaining the best overall results. We will look at these with a topic-based outline.

Calibration

While all Rapid RH sensors come from the factory with a known accurate calibration accompanied with a certificate of NIST traceability, there are some issues with calibration as time moves forward. The F2170 standard calls for the recalibration of the sensor on an annual basis (or more often if calibration is suspect due to exposure of harsh chemicals, failing an accuracy check using saturated-salt based solution, etc.). It also requires a sensor to have its calibration verified, by the user, within 30 days prior to each usage. The best and most cost-effective way to achieve this is with saturated salt solutions as defined by ASTM E104 as recommended by ASTM F2170.

Every Rapid RH 5.0 sensor comes standard with its own saturated salt solution EasyCare CalCheck®. The EasyCare CalCheck is a unique device for a number of reasons, most notably perhaps

because normal potable water may be used with the device because it incorporates an automatic distillation process to create pure water for use in the salt water mixture. The EasyCare CalCheck has the following features:

- Normal potable water is used in the bottom water fill chamber.
- The top chamber, which also holds the salt works to provide a distillation chamber that purifies the water from the bottom chamber, creates a pure water and salt saturated salt solution.
- Over time, the saturated salt solution will “dry out,” but more potable water can be added to the bottom chamber and within one day, the top chamber will once again be producing a known RH-equilibrated environment for which to store and perform a calibration check on a sensor at any time.
- The EasyCare CalCheck easily attaches to a standard Rapid RH 5.0 sensor housing through a compression fitting.
- The salt provided should easily last the entire year that the E104 suggests it should.
- The salt solution chamber is isolated by two separate PTFE filters, blocking all liquids and macro molecules that might otherwise contaminate the saturated salt solution.

There are two main concerns when using any RH sensors provided by any sensor manufacturer. The first is potential upset of factory calibration due to over-exposure to chemicals that might damage the sensing element, and the other is long-term drift.

Let us look at the latter concern, that of the sensor’s accuracy becoming upset with no apparent reason, other than that caused by long-term drift. The ASTM F2170 standard actually provides for a mechanism to detect this eventuality by requiring that sensors be checked for calibration prior to being put to further use. It further recommends using saturated salt solutions as defined by ASTM E104. The EasyCare CalCheck conforms to E104 and provides for a well-known %RH environment for

which to test the sensor and confirm whether the sensor is out of calibration. Our EasyCare CalCheck is 75% RH-based on sodium chloride.

There are some simple requirements that must be observed to properly use the EasyCare CalCheck. The first is to realize that once a sensor is attached to an EasyCare CalCheck, it must be allowed to come into equilibrium, much the same way as a sensor that is freshly placed in a concrete sleeve must do. Our testing shows that this equilibration time should only take up to an hour or less if the EasyCare CalCheck is properly equilibrated to its environment and the sensor being placed atop the EasyCare CalCheck is also at the same ambient temperature equilibration as the EasyCare CalCheck. It should be recognized that saturated salt solutions are dependent on ambient temperature. For instance, when temperature is 68 degrees F, sodium chloride provides an RH of 75.47% +/- 0.14% RH, but at 77 degrees F, the RH produced by sodium chloride saturated solution will be 75.29% +/- 0.12% RH. Tables for the RH dependency on temperature for different saturated salt solutions are provided in the ASTM E104 standard.

For those customers who have one of our Smart Readers and are using our DataMaster® 4.0/5.0 mobile app* (iOS or Android), once a reading is taken, the mobile app will automatically indicate whether the sensor has passed or failed the cal check. If one is simply using a salt solution with tables provided by ASTM E104, it can sometimes be confusing as to whether the reading is appropriate or not. Another point to realize as indicated in the E104 standard is that ambient temperature fluctuations around a saturated salt solution will require a bit of time to allow the saturated salt solution to come back into equilibrium with the ambient temperature conditions. Do not be immediately alarmed if a 5.0 sensor “fails” to pass a calibration check test, as it is probably in most cases that the sensor is OK, but that the EasyCare CalCheck and/or sensor is just not currently equilibrated to the ambient temperature and so a few more hours of time should be allowed to pass to allow for this, and then a re-check performed.

*** Please note:** The DataMaster 4.0/5.0 is a free mobile app designed to work with the Rapid RH 5.0 EasyCare CalCheck to verify calibration. DataMaster 4.0/5.0 records and tracks the necessary data for complying with ASTM F2170 calibration verification requirements in a database, where you can access it as needed. For all of this plus more job specific moisture measurement functionality, check out the app at www.RapidRH.com/DataMaster.

Best Practices

1. Allow enough time for equilibration before verifying accuracy, overnight being optimal if a sensor has just been attached to an already-charged EasyCare CalCheck unit (assuming both sensor and EasyCare CalCheck are equilibrated to the same ambient temperature – otherwise a longer time will be needed to first equilibrate to the same ambient temperature), or 48 hours if the unit must first charge by adding water to the bottom chamber.
2. If a manual accuracy check is done without our DataMaster 4.0/5.0 mobile app and it fails, ensure you are allowing for the ASTM-specified $+/- 2\%$ RH measurement tolerance of the sensor and the E104-allowed accuracy of the salt solution (typically between 0.2% and 0.6% RH depending on temperature and salt – refer to E104 document chart for details) and/or if recent ambient temperature fluctuations have occurred, allow for a few more hours of re-equilibration time before retesting.
3. If a DataMaster 4.0/5.0 app accuracy check fails, be sure you have allowed for enough equilibration time to lapse if recently installed, and if recent ambient temperature fluctuations have occurred, allow for a few more hours of re-equilibration time before retesting.
4. Verify accuracy before leaving for the job site.
5. Have a few extra sensors on hand for those times when, perhaps, a sensor has finally seen its useful lifetime.

6. When refilling an EasyCare CalCheck with water, be sure to fill the bottom to almost full, but not overly and allow 48 hours of charge time.
7. Once the top chamber is fully charged (72 hours for initial charge), separate the top chamber from the bottom chamber. Store the bottom chamber for future recharging processes. Take the top chamber and insert it into a provided red rubber cap. This lessens the potential for evaporation and premature recharging. At this point, either cap the top chamber with a Smart Sensor while performing calibration verifications and/or with another red rubber cap.
8. Periodically ensure the top chamber of your EasyCare CalCheck has water inside. If the top chamber does not exhibit at least a “wetted” salt (saturated salt solution), then refill the bottom chamber, attach to the top chamber, and allow to recharge for 48 hours.
9. Always keep either a sensor or the supplied rubber cap covering the top chamber of the EasyCare CalCheck. Also, ensure the top chamber is inserted into a red rubber cap, both of which help prevent “over-charging”, which could occur where the water vapor from the ambient air diffuses through the top PTFE filter into the EasyCare CalCheck top chamber. This would occur when the ambient RH is greater than the internal RH of the EasyCare CalCheck. If this happens, damage might occur to the PTFE filters, and they would need to be replaced.
10. Always keep either a sensor or the supplied rubber cap covering the top chamber of the EasyCare CalCheck. Also, ensure the top chamber is inserted into a red rubber cap, both of which help prevent “discharge” (the water vapor from escaping through the top PTFE filter into the ambient atmosphere where the ambient RH is less than the internal RH of the EasyCare CalCheck). If this happens, just refill the bottom chamber with water, attach to the top chamber, and allow 48 hours to recharge.

11. Ensure a very good fit with the top and bottom rubber cap and the top chamber of the EasyCare CalCheck unit.
12. When you have a sensor on the **top** chamber of the EasyCare CalCheck, also make sure it is seated fully in a red rubber cap, and resting in one of the compartments of the EasyCare CalCheck acrylic tray. In your office or lab environment, this will help minimize the effects of temperature fluctuations on the saturated salt solutions contained in the EasyCare CalCheck upper chamber, and help optimize successful calibration checks.
13. Be careful when adding additional water to the lower chamber when recharging an EasyCare CalCheck. Follow the instructions very closely, so you can be sure not to overfill the bottom chamber.
14. If you suspect an EasyCare CalCheck is not providing the correct RH environment for checking calibration of sensors, then swap the sensor being tested and its EasyCare CalCheck with a known good sensor that you verified with its EasyCare CalCheck. Place the known good sensor on the suspect EasyCare CalCheck, wait about 3 hours and then test both sensors to see if the problem is with the sensor or with the EasyCare CalCheck.
15. If you must hold an EasyCare CalCheck in your hand when performing a test, always handle it with the rubber base (the rubber cap for storing EasyCare CalCheck should be used as the base when EasyCare CalCheck is in use) and try not to handle the acrylic part or the sensor plastic part when taking apart an EasyCare CalCheck, as this will impart heat into the unit and upset the internal saturated salt solution equilibrium, causing a potential “Out-of-Cal” reading.
16. If you notice some “salt” film on the outside of the EasyCare CalCheck on top of the PTFE filter, indicated by a thin white substance, then most likely there has been a breach in the PTFE filter caused by either age or over-pressurization; in either case, please replace the EasyCare CalCheck to

continue receiving the good benefits provided by using an EasyCare CalCheck.

17. Be careful to not “overcharge” an EasyCare CalCheck. There should always only be enough water in both top and bottom chambers to fill the top chamber to near completion; i.e. if the top chamber is 50% filled, then the bottom chamber should only contain enough “extra” water to complete charging of the top chamber. Once the top chamber is fully charged, separate the top chamber from the bottom, storing the bottom chamber for future recharging processes. Any water in excess of that amount may cause overcharging and damage to one or more of the PTFE filters, rendering the EasyCare CalCheck unusable.
18. There is a tiny vent slot in the top/side of the bottom chamber of the EasyCare CalCheck. This is to help minimize the potential for overcharging as indicated in ASTM E104. Once the top chamber is charged (72 hours), replace the bottom chamber with a red rubber cap; this will greatly increase the time it takes for the top chamber to discharge and decrease the frequency by which you will need to recharge the top chamber. If you notice some salt “creep” adhering to or building up just outside the vent hole opening, this is an indication that the underside PTFE filter has been compromised, and you should replace the EasyCare CalCheck unit.



For more information
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or call us worldwide toll-free: (844) 808-8765