SmartCal™ User Guide

Verified
Performance
Fast Results
Easy Testing

How to test
FAQ
Product information

Reference Substance to Test

Halogen Moisture Analyzers

METTLER TOLEDO

Product Information SmartCal

Product name:	cSmartCal, SmartCal
Substance:	Molecular sieve (Zeolite) This substance is not classified as dangerous. Avoid ingestion. For detailed information the material safety datasheet (MSDS) is available on the internet: **www.mt.com/msds**
Intended use:	Reference substance for the performance verification of Moisture Analyzers. Not suited for microwave moisture analyzers.
Storage:	Store at room temperature. Do not open the blister pack before use.
Disposal:	Can be disposed of as normal waste. Observe local and national environmental regulations.
Shelf life:	The expiry date is printed on blister pack and stick. When correctly stored the functionality of SmartCal is guaranteed until that date (e.g. Exp08.2013).
Certificate:	The Certificate of Analysis of cSmartCal and the production certificate of SmartCal is available as a PDF-file at: **www.mt.com/smartcal-certificate**
Order information:	cSmartCal, set of 24: 30005791 cSmartCal, set of 12: 30005793 SmartCal, set of 24: 30005790 SmartCal, set of 12: 30005792 StarterPac cSmartCal: 30005918 StarterPac SmartCal: 30005917 Certified adjustment weight 50 g (for HG/HR), F1 class: 11119530 Certified adjustment weight 20 g (for HB), F1 class: 11119529 Certified adjustment weight 100 g (for HX/HS), F1 class: 11119531 Certified temperature adjustment set, HA-TCC: 00214528 HX/HS Moisture Analyzer 30020851

Contents

The SmartCal StarterPac includes:

- Set of 12 cSmartCal or SmartCal
- Thermohygrometer
- SmartCal User Guide

- CD with
  - SmartCal User Guide
  - SmartCal Short Operating Instructions
  - Excel® Measurement Reports
  - Normalization table
  - SOP

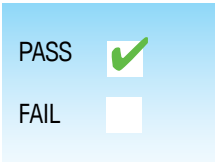
1. Introduction

Moisture analyzers provide fast, precise and reliable determination of moisture content. An incorrect moisture result can directly impact production processes and final product quality.

Regular verification of the measuring device is essential to ensure valid results and maintain quality. In the case of a moisture analyzer, the balance and the heating module are traditionally checked separately using a weight and a thermometer. Whilst these tests verify the functionality of the individual components, the testing process is time-consuming and cumbersome, often leading to operators leaving long intervals between calibrations and thus to an inadequate monitoring of the instrument – a risk in quality control.

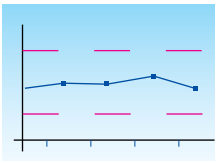
To ensure quality moisture results at all times, METTLER TOLEDO offers SmartCal. This unique temperature sensitive substance with a known moisture content is used in one single test to quickly and easily verify the instrument's overall functionality. The SmartCal test is based on a regular measurement with a moisture analyzer. SmartCal contains a specific amount of moisture which makes it an ideal reference substance for the performance verification of moisture analyzers.

Using SmartCal you get...

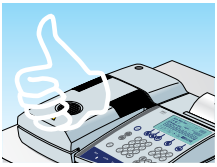


- a clear indication if the instrument is working within manufacturing specifications and can therefore be released for routine measurements.

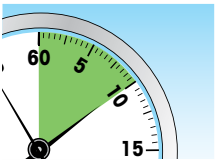
- documented test results about instrument performance – supporting your quality documentation for audits.



- a trend of the instrument performance at a glance.



- an easy instrument test procedure which can be performed by non-skilled operators.



- fast results – the test takes only 10 minutes.

- a certified and fully traceable testing substance (cSmartCal).

SmartCal – the routine test for moisture analyzer validation.

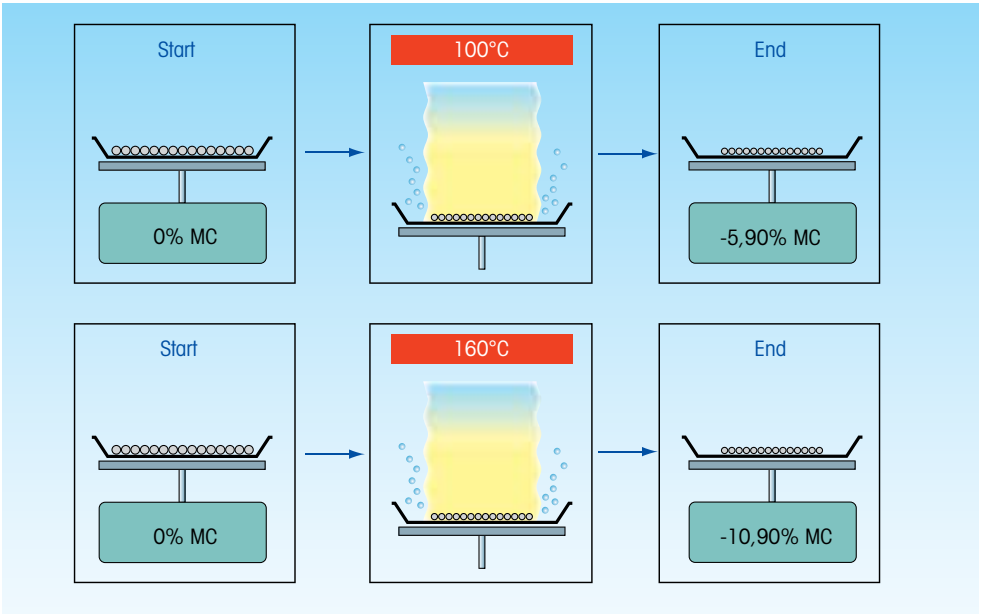
2. Working Principle of SmartCal

2.1. Routine tests of moisture analyzers

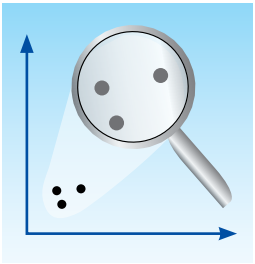
The result of a thermogravimetric measurement (loss on drying) is dependent upon an accurate weighing instrument and a heating device able to achieve the specified drying temperature. In order to obtain valid results it is crucial to be sure that both devices, i.e. balance and heating source, are functioning correctly. This confidence is achieved by periodical calibration of the measurement devices.
A moisture analyzer consists of a heating device and an integrated balance. Such an instrument is conventionally calibrated with a test weight and a temperature calibration kit. This procedure is time-consuming and tedious, and calibrations are often not performed frequently enough – a blind spot in moisture analyzer quality control. This issue is addressed by using SmartCal, an innovative easy to use reference substance, to quickly verify the proper functioning of the whole instrument. The test substance is handled in the same way as a real sample. However, by using a substance with a known moisture content (see 4. "Control Limits"), the test procedure provides a practical, fast and direct method of instrument verification.

2.2 SmartCal verifies instrument performance near point of use

When determining moisture content using a moisture analyzer, the result for most substances depends upon the selected drying temperature – as with any other thermogravimetric measurement. Hence, it is very important that the selected drying temperature is achieved and, for this reason, the instrument should be verified at or as close as possible to the typical point of use (drying temperature).
As previously stated, SmartCal contains a specific amount of moisture. A defined amount of the moisture is released according to the drying temperature (see 4. "Control Limits"). It is this characteristic which makes SmartCal the ideal reference substance for the performance verification of moisture analyzers. METTLER TOLEDO offers control limits for SmartCal near to all of the most commonly used drying temperatures, i.e. 70 °C, 100 °C, 130 °C and 160 °C.



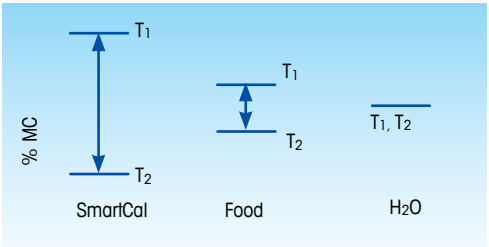
2.3 SmartCal functions like a magnifying glass



Because even small changes of the instrument should be detected, the test substance must show a big change of moisture content even when the instrument's characteristics change only slightly. For this reason, SmartCal can be compared to a "magnifying glass" as it identifies even marginal instrument changes with relatively big differences in the moisture results.

2.4 Comparison to real samples

Typical samples are not as sensitive as SmartCal to drying temperature changes. The figure illustrates the magnifying glass characteristics of SmartCal which shows a much wider moisture range compared to typical substances



Moisture results with decreasing temperature sensitivity from left to right.

2.5 cSmartCal – highest security for highest requirements

Two versions of SmartCal are available. SmartCal with a production certificate from METTLER TOLEDO and cSmartCal which is tested and certified by an independent and accredited national testing institute (BAM – Federal Institute for Materials Research and Testing, Germany) and possesses full traceability to the SI unit (kg) and includes a statement of uncertainty. cSmartCal is suitable for companies requiring the highest level of security in order to fulfill the strictest regulations.

Each lot-specific Certificate of Analysis (cSmartCal) and production certificate (SmartCal) is archived and can be found by lot number on

▶ **www.mt.com/smartcal-certificate**.

3. Test Procedure with SmartCal

This chapter describes the basic measurement procedure of the SmartCal test. Chapter 6 "How to obtain best results with SmartCal" explains best practice using SmartCal including issues such as correct adjustment of the moisture analyzer, preconditions for the SmartCal test and improvement of repeatability.

3.1. Preconditions

- Correct instrument installation (no drafts, no direct sunlight, stable location)
- Correct adjustment under operating conditions
- Moisture analyzer acclimatized in measuring room and connected to AC power for at least one hour.
- Cooled heating chamber.
- SmartCal package acclimatized in working area.
- Thermohygrometer acclimatized in working area.

These are the most important preconditions for correct use of SmartCal. If increased repeatability and accuracy of the SmartCal test is required, please see section 6. "How to obtain best results with SmartCal".

3.2. Instrument settings (method parameters)

- Switch-off time: 10 minutes
- Standard drying
- Display: % MC
- Drying temperature: 70, 100, 130 or 160 °C
  (select the temperature closest to the drying temperature normally used).

3.3. Making the measurement

- Place the sample pan handler with the aluminum sample dish in the instrument and tare.
- Remove a SmartCal stick from the blister pack, tear it open, and distribute the entire contents evenly over the sample pan (if necessary, carefully rotate and tilt the dish until it is fully covered with granulate).
- Start the measurement immediately.

3.4. After the measurement (10 minutes)

- Enter the indicated moisture reading (% MC) in the measurement record. Excel® measurement records for the different drying temperatures are available on the CD-ROM accompanying the SmartCal StarterPac or at www.mt.com/SmartCal. The CD-ROM also has measurement records that can be printed out and filled in manually.
- Enter the room temperature and relative humidity in the measurement record.
- Normalize the moisture reading (this is necessary if the room temperature is not 20 °C and the relative humidity is not 50%). Normalization is performed automatically if the Excel® measurement record is used.
  For manual normalization, the table on page 28 of these instructions should be used. This table is also on the CD-ROM accompanying the StarterPac. Enter the normalized moisture reading (% MC_N) in the measurement record.

TIP: Detailed information on why and when normalization is necessary and how to do the normalization is given in section 6.3 "Normalization to ambient conditions".

3.5. Evaluation

Compare the normalized moisture reading to the control limits (see page 12):

- If the value is within the tolerance range, the instrument has passed the functional test;
- If the value is outside the tolerance range, there may be a problem with the instrument or the test conditions may not have been met.

When a result is outside the control limits:

1. Identify possible causes for the outlying value (see 5.2 "Potential reasons for outlying values").
2. Correct the cause.
3. Repeat the SmartCal measurement (important: let the instrument cool down before starting the next SmartCal test).
4. If the result is still outside the limits, adjust the instrument using a weight and temperature calibration kit (important: let the instrument cool down before starting this adjustment).
5. Repeat the SmartCal measurement (important: let the instrument cool down before the test).

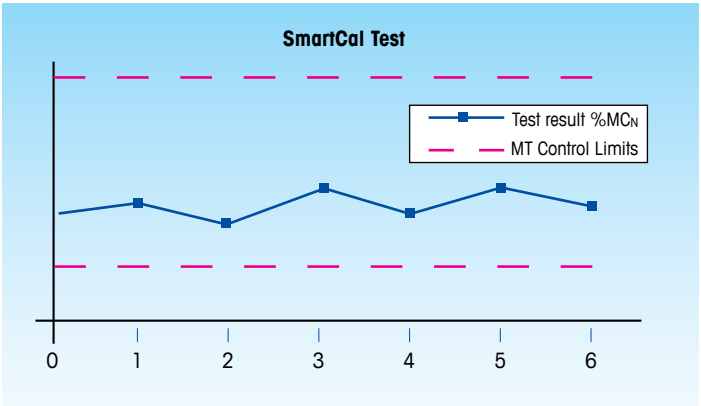
Additional support is available from METTLER TOLEDO Service. Further suggestions on how to evaluate test results are given in section 5.1 "Examples of typical test results and deviations".

4. Control Limits

SmartCal verifies the instrument's functionality with a normal routine measurement procedure. If the instrument is correctly installed and set up, all results from the SmartCal test should lie within the control limits given for the specific test temperature.

Note: These control limits cover all product lines of METTLER TOLEDO Halogen Moisture Analyzers and are only applicable for those instruments.

METTLER TOLEDO control limits (pink lines).



If the moisture analyzer is working correctly, the SmartCal test results should lie within the control limits, however not necessarily in the middle of the specified range.

Test Temperature [°C]	cSmartCal control limits [%MC_N]	SmartCal control limits [%MC_N]
70	3.3 - 4.3	3.2 - 4.4
100	5.3 - 6.3	5.2 - 6.4
130	7.5 - 8.7	7.4 - 8.8
160	10.0 - 11.6	9.9 - 11.7

The control limits of cSmartCal and SmartCal at 4 different test temperatures. Valid for METTLER TOLEDO Halogen Moisture Analyzers. MC_N: Normalized to 20°C and 50% RH.

The specified range is smaller for lower testing temperatures. The relative error of the target temperature is always the same, thus the absolute error is smaller for lower temperatures and bigger for higher temperatures. Samples requiring higher testing temperatures typically have lower temperature sensitivity and a wider tolerance is acceptable.

Measurements in special surroundings or untypical handling

SmartCal control limits are based on results of moisture analyzers being used in standard working situations (see 3.1 and 6.2 "Preconditions for SmartCal testing"). When the moisture analyzer is used in special surroundings such as exposure to air flows (e.g. caused by a fume hood) or untypical handling (e.g. working without a pan handler or with a warm instrument), the SmartCal values may lie outside of the control limits. However, if the test conditions remain the same, SmartCal can still be used to assess instrument performance over time, corresponding control limits can be established if required.

TIP: **SmartCal test with a warm moisture analyzer (if always in use)**
As with a conventional calibration or adjustment, the SmartCal test should be done with a cold instrument. Only this can guarantee identical instrument conditions to ensure repeatable results inside the control limits.* If however, the instrument is always in use so that a SmartCal test with a cold instrument is not possible, a SmartCal test measurement can still be done but will result in a higher than usual moisture content. To achieve the best repeatable results, we recommend keeping the start conditions as similar as possible. Start conditions depend on the previous use of the instrument (drying temperature, drying time, time elapsed since last measurement).

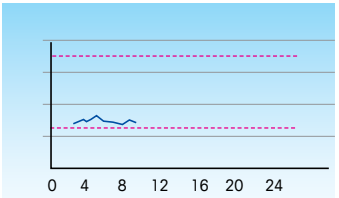
* If a fixed time is used as the switch-off criterion, the moisture result is more dependent on the initial state.

5. Interpretation of SmartCal test results

5.1 Examples of typical test results and deviations

Some typical SmartCal results are presented to give guidance on how to evaluate the test result and what to do in case of deviations. The interpretation is based upon the theories of the Westgard Rules (www.westgard.com/westgard-rules).

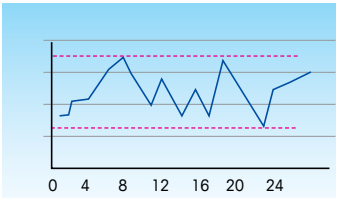
Case
Normal situation: All SmartCal test measurements are within control limits



Case
All test measurements are very close to upper or lower control limit

Description
Although the values need not be in the middle of the specification range, values close to the extreme limits can be an indication of a systematic error (e.g. instrument installation, preconditions, SmartCal test measurement and normalization).

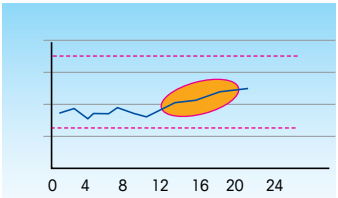
Corrective Action
To bring the SmartCal values closer to the middle of the specification range, refer to chapter 6. "How to obtain best results with SmartCal".



Case
All SmartCal test measurements are within control limits but scatter significantly

Description
Typical indications for a wide scattering of measurements are unstable test conditions such as drafts, handling or using a warm instrument.

Corrective Action
To get better repeatability refer to chapter 6.4 "Improve repeatability of SmartCal results".



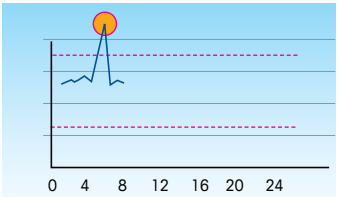
Case
SmartCal test results show a trend

Description
Several consecutive test measurements show a trend in the same direction.

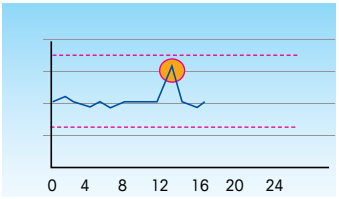
Possible reasons could be:
- Normalization not performed correctly.
- The protective glass is contaminated.
- The reflector is contaminated.
- The temperature sensor is defective or contaminated.
- Instrument is defective.

Corrective Action
- Verify that normalization is done correctly.
- Calibrate both heating module and balance and adjust if necessary.
- Clean or change protective glass.
- Change reflector.
- Change temperature sensor/cable (by MT service technician).

A: Outside control limits



B: Inside control limits but significant deviation from previous measurements

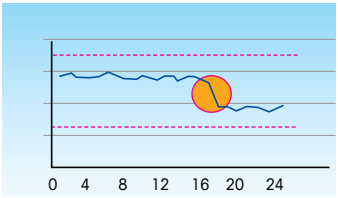


Case
Single measurement deviation

Description
A single measurement is outside the control limits (A) or deviates significantly from the previous measurements (B). This typically indicates an error in the handling or test conditions and does not necessarily mean that the instrument is performing incorrectly.

Corrective Action
If a measurement is outside the specified range, repeat the measurement with fresh test substance. Refer to 5.2 "Potential reasons for outlying values", and make sure that possible causes have been considered before starting the new measurement.

Observe subsequent measurements closely. If the test result is similar to the earlier measurements then it can be considered to be a single faulty measurement and the instrument still working properly. If the repeated measurement is still outside the limits or differs significantly from other values and all error sources can be excluded, the instrument must be checked.



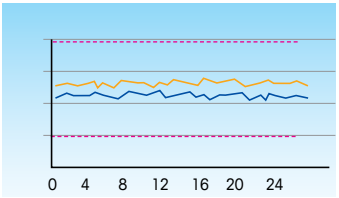
Case
Measurement values show a step

Description
There is a significant deviation from previous to subsequent measurement series; both series show good repeatability and are inside the control limits.

This jump and the good repeatability before and after the jump are an indication for a significant change in measurement conditions:
- instrument moved
- change of ambient conditions (air flow, air conditioning)
- adjustment of the instrument
- change of test method parameters
- SmartCal production tolerances

Corrective Action
- Calibrate the Halogen Moisture Analyzer and adjust if necessary.
- Check use of correct test method parameters.
- If instrument has been correctly adjusted under the same working conditions and this is the reason for the step, then no corrective actions need to be carried out.

TIP: If only the current status of the instrument needs to be checked, e.g. because of a routine test, it is sufficient and advized to perform only a calibration. It is recommended to perform an adjustment only if the calibration is out of tolerance.

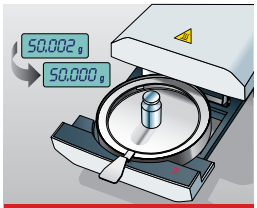


Case
Differences between two moisture analyzers

Description
When two or more instruments are tested with SmartCal, each instrument will display its own range of SmartCal moisture results even when all instruments are adjusted correctly. This can be explained because SmartCal is a very sensitive test substance and magnifies even small production variations and differences in construction between instruments and different product lines (HR, HG or HB) (see also 4. "Control limits"). Furthermore, variations in working environments such as air drafts will cause differences in SmartCal test results between instruments.

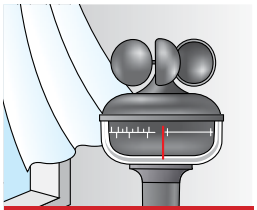
5.2 Potential reasons for outliers

Installation and maintenance



Not adjusted

Not adjusted


Air draft

- The instrument has never been adjusted, was not adjusted correctly or not adjusted under working conditions.
- The correction values of the temperature calibration kit (HA-TCC) were not applied correctly.
- The temperature calibration kit is defective.
- The instrument location has been changed after the last adjustment/ calibration.
- The instrument is exposed to air draft (open window, fan, air conditioning, fume hood).
- The protective glass, reflector or temperature sensor is contaminated or broken.
- The ambient temperature has changed significantly since the last adjustment/calibration.
  For proper installation see 6.1 "Correct adjustment of the moisture analyzer" and Moisture Guide ▸ **www.moisture-guide.com**.

Handling

- The wrong method settings were used.
- The normalization to ambient conditions was not done or done incorrectly (refer to 6.3 "Normalization to ambient conditions").
- The instrument was not completely cool before starting the test.
- After opening the SmartCal stick the test was not started immediately.
- The whole contents of the SmartCal stick were not poured on the sample pan.
- The sample was not evenly distributed over the sample pan.
- The sample pan was deformed.
- The sample pan grazes the pan handler or the draft shield, the draft shield was not centered correctly.
- The instrument was not acclimatized or connected to the power supply long enough.
- The sample pan handler was not used.

Evenly distributed

Not evenly distributed

Test substance

- The stick or the seal were damaged.
- SmartCal was not stored according to recommendations (see 10. "Product Information SmartCal").
- SmartCal shelf-life has expired.

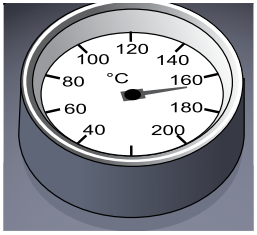
Not evenly distributed

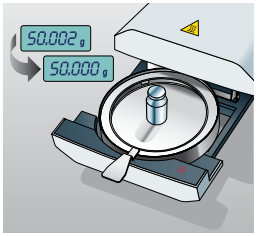
6. How to Obtain Best Results with SmartCal

Moisture measurement using a moisture analyzer is based on sample drying combined with a high precision weighing procedure. Thus, accuracy and repeatability are closely linked to the quality of the instrument installation. Instrument installation includes consideration of the location and environment of the instrument together with correct adjustment of the balance and heating device.

SmartCal is a reference substance which indicates if your moisture analyzer is correctly installed and working within manufacturer specifications.
Please observe the following guidelines to obtain SmartCal results inside the control limits with good repeatability.

6.1 Correct adjustment of the moisture analyzer





- The balance and heating module should be adjusted:
  - when the moisture analyzer is operated for the first time,
  - after changing the location of the instrument,
  - after major changes to room temperature,
  - after leveling (balance only).
- Adjust the moisture analyzer under conditions in which it will be operating.
- Preferably use a certified weight and a certified temperature calibration kit (HA-TCC) and remember to apply the correction value of the thermometer (documented in the certificate).
- The thermometer, weight and moisture analyzer need to be cold (i.e. room temperature) before starting an adjustment/calibration. Wait at least one hour after a moisture determination before calibrating or adjusting the moisture analyzer.

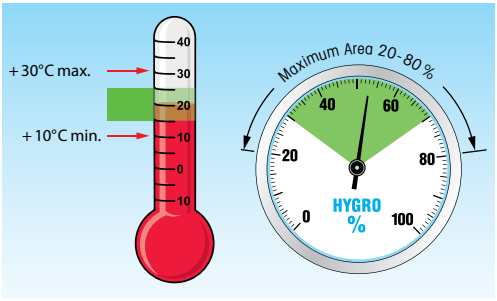
For more information regarding the installation of your moisture analyzer
▶ **www.moisture-guide.com**

6.2 Preconditions for SmartCal test

- The heating compartment should be at room temperature. After a moisture determination please wait approximately 1 hour to allow it to cool down completely before starting the SmartCal measurement.
- Use the sample pan handler.
- Avoid air currents (open windows, fan, air conditioning).
- The moisture analyzer should be acclimatized to room conditions.
- The instrument should be connected to the power supply for at least 1 hour.
- The thermo-hygrometer used for normalization should be acclimatized to room conditions.

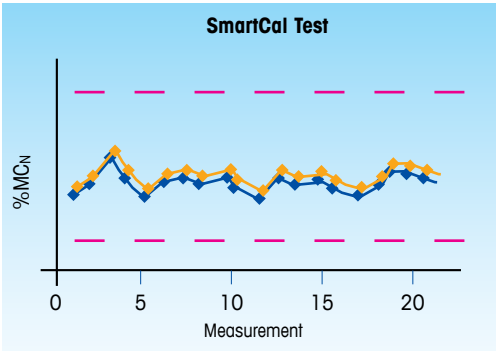
6.3 Normalization to ambient conditions

The SmartCal specifications correspond to measurements conducted under the standard conditions of 20 °C and 50% relative humidity (RH). If a SmartCal test is performed in different conditions the test result (% MC) differs from the result under standard conditions but can be normalized (% MC_N) with a correction value. This correction value is determined using the ambient conditions found during the test measurement.

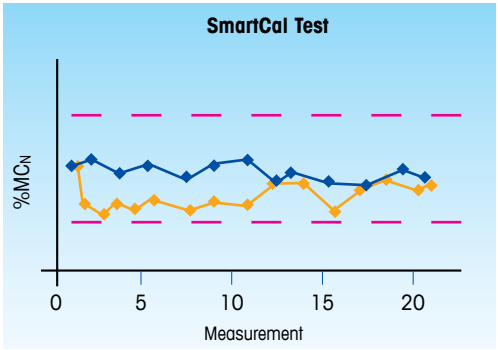


1. Examples Normalization

Two cases are shown below to demonstrate why and when it is important to perform normalization and when it can be considered unnecessary.



These measurements were performed under stable ambient conditions. The room temperature varied between 19 and 21 °C and the relative humidity between 47 and 53% throughout all measurements. The normalized (blue line) and the non-normalized (yellow line) measurements are nearly identical. This means if you are working in an area with moderately stable climatic conditions around the standard conditions (20 °C, 50% RH) throughout the year, you do not necessarily have to normalize the SmartCal moisture results.



If however, your working environment deviates significantly from the standard conditions or if the ambient conditions vary a lot, you should normalize your moisture results as can be seen in this example. Here, the measurements were performed at temperatures between 16 and 22 °C and relative humidity between 23 and 79%. The two curves differ due to the variation in ambient conditions. However, the normalized measurements (blue line) show good repeatability of the instrument.

2. Thermo-hygrometer for normalization

To calculate the correction values, the temperature and relative humidity need to be recorded by a thermo-hygrometer. The SmartCal StarterPac contains a suitable thermo-hygrometer enabling you to immediately begin your moisture analyzer performance check with SmartCal. If you require a certified thermo-hygrometer we recommend two international suppliers with worldwide service.

Elpro-Buchs AG: **www.elpro.com**

Rotronic AG: **www.rotronic-humidity.com**

3. Calculation of normalized moisture content (MC_N)

Normalization of the moisture content displayed after the SmartCal measurement can be done either manually or with the Excel® measurement report.

Manual Normalization

Normalization is done by adding the correction value provided in the correction chart (see Table) to the result of the SmartCal measurement:

$$\%MC_N = \%MC + \text{correction value}$$

Record the ambient conditions with the thermo-hygrometer and select the correction value for these conditions. This normalization table is provided on the CD in the StarterPac or at **www.mt.com/smartcal**.

		Room Temperature [°C]						
		10	15	20	25	30	35	40
	20	-0,31	-0,28	-0,24	-0,18	-0,12	-0,03	0,07
	25	-0,29	-0,25	-0,20	-0,13	-0,05	0,06	0,19
	30	-0,27	-0,22	-0,16	-0,08	0,02	0,16	0,31
	35	-0,24	-0,19	-0,12	-0,03	0,09	0,24	0,42
	40	-0,22	-0,16	-0,08	0,03	0,16	0,33	0,54
Rel. Humidity [%]	45	-0,20	-0,13	-0,04	0,08	0,23	0,42	0,66
	50	-0,18	-0,10	**0,00**	0,13	0,30	0,51	0,77
	55	-0,16	-0,07	0,04	0,18	0,37	0,60	0,89
	60	-0,14	-0,04	0,08	0,24	0,44	0,69	1,01
	65	-0,12	-0,01	0,12	0,29	0,51	0,78	1,12
	70	-0,09	0,02	0,16	0,34	0,58	0,87	1,24
	75	-0,07	0,04	0,20	0,39	0,64	0,96	1,36
	80	-0,06	0,07	0,24	0,45	0,71	1,06	1,47

Correction Values to correct SmartCal result to standard conditions.

The normalization table is presented in steps of 5 °C and 5% RH. If the ambient conditions are between these steps, the correction value can be estimated.

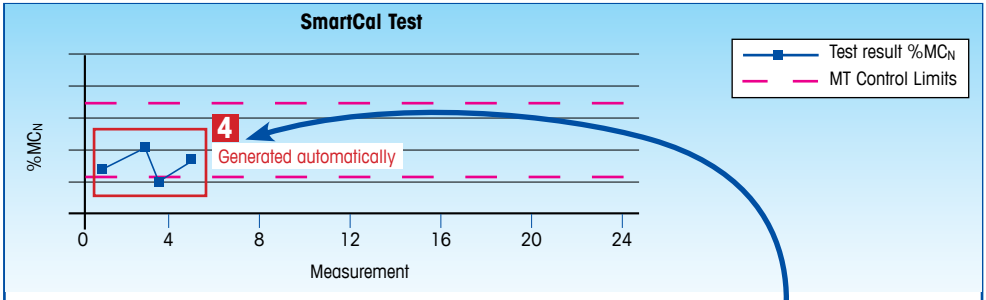
Example 1:	
% MC from SmartCal measurement	5,56%
Relative Humidity	55%
Room temperature	25 °C
correction value for 55% RH and 25 °C	+ 0.18%
$\%MC_N$ = %MC + correction value	**5,74%**

Example 2:	
% MC from SmartCal measurement	5,92%
Relative Humidity	36 %
Room temperature	17 °C
estimated value for 36% RH and 17 °C	-0.15%
$\%MC_N$ = %MC + correction value	**5,77%**

Normalization with electronic measurement report

SmartCal StarterPac contains a CD with an electronic measurement report based on Excel® (see Figure below). There is one Excel® report for each SmartCal test temperature. Type in the ambient conditions (step 1) and enter the moisture content determined with the SmartCal measurement (step 2). Excel® automatically calculates the normalized moisture content (MC_N) and compares the result with the control limits of the respective test temperature (step 3). Visualization in a diagram is also carried out automatically (step 4). Please use one measurement report for each instrument.

SmartCal Excel® measurement report for test temperature 100°C.



Date	Time	Environmental Conditions		Test Results			Remarks	Name
		%RH	°C	%MC	$\%MC_N$	Within limits		
16.03.2010	16.10	63	17.5	5.57	5.60	Yes		
17.03.2010	16.00	36	17	5.92	5.76	Yes		
18.03.2010	09.30	57	19.5	5.21	5.25	NO		
19.03.2010	14.30	74	17.5	5.52	5.62	Yes		

1 Typing in

2 Typing in

3 Generated automatically

6.4 Improve repeatability of SmartCal test results

Repeatable SmartCal results depend on factors such as the handling of the SmartCal sample, reduction of external interferences and meeting the preconditions for the SmartCal test (see 6.2 "Preconditions for SmartCal measurement").

Handling of SmartCal

- Use the sample pan handler
- Use aluminum sample pans
- After opening the SmartCal stick, pour and distribute the contents evenly over the whole sample pan.
- Use the complete contents of the stick (target weight 8.5 g).
- Start the test measurement immediately.

Reduction of external interferences

- Avoid air flows (e.g. open windows, open doors). If the SmartCal test is performed under strong or changing air drafts the result will be less repeatable and may be out of the control limits (typically too high a result).
- Perform the SmartCal test under environmental conditions between 10 and 30 °C and 20 to 80% RH. We recommend using SmartCal at 15 °C to 25 °C and 30% to 70% RH.

7. Recommended Testing conditions

7.1 Test Frequency

For a recommendation based on your individual process please visit
www.mt.com/smartcal-frequency-recommendation

A specific test frequency cannot be generally recommended since the frequency depends upon the risks associated with the individual processes for which the moisture application is being used. The main factors influencing the test frequency are the potential impact of incorrect measurements on the business process, people or the environment, and the criticality of the process or of the sample. Depending on these factors, the testing frequency can vary from daily up to quarterly measurement intervals.

Calibration and maintenance

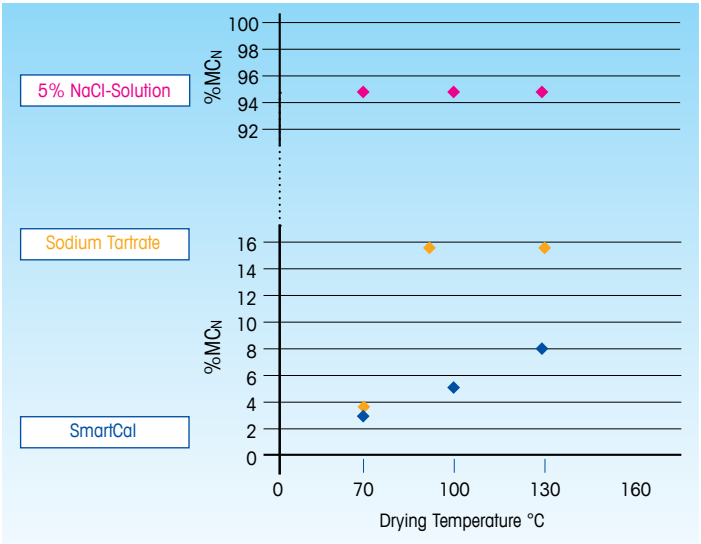
SmartCal is a performance check that facilitates better control of the quality of the measurement results. However, this rapid test does not replace preventive maintenance, adjustment and functional tests. Periodical calibration with certified weights and temperature calibration kit must be performed to assure traceability and proper functioning of all components.

7.2 Testing Temperature

It is recommended to verify the instrument at or near working conditions. For this reason, please choose the SmartCal testing temperature (70 °C, 100 °C, 130 °C, 160 °C) nearest to your drying temperatures. In particular, near to the drying temperatures of temperature sensitive substances.

8. Comparison with Other Test Substances

Sodium tartrate is a substance which contains a chemically defined amount of crystal water (15.66%). However, sodium tartrate is limited to verifying only the weighing system. A moisture determination of sodium tartrate at 130 °C or 160 °C results in approximately the same moisture content (ca. 15.66 %, see Figure). It is therefore unsuitable for verifying the performance of the heating device as it is not possible to identify a deviation from the selected to the actual drying temperature. This applies to all non temperature sensitive substances (e.g. a solution of sodium chloride). SmartCal, on the other hand, is a temperature dependent test system: the higher the drying temperature, the higher the moisture content measured (see Figure).



9. Frequently asked questions

1. Why are my SmartCal test results not in the middle of the control limits?

The SmartCal test results of a correctly adjusted and installed instrument need not necessarily be in the middle of the control limits. The mean value of this range is the mean value of all product lines of METTLER TOLEDO Halogen Moisture Analyzers and not the target value for each instrument.

2. Can I do warm start measurements with SmartCal?

In principle it is possible to perform SmartCal tests with a warm instrument if the starting conditions are the same. The goal of a test measurement is – as with the temperature calibration or adjustment – to have as similar starting conditions as possible to obtain best repeatability. Defining a cold start gives clear and distinct starting conditions.

For a real moisture determination, the typical switch-off criterion is weight loss per time (mg/s). Thus, the moisture result correlates to the level of dryness of the sample and is less dependent on the instrument's initial state. If a fixed time is used as the switch-off criterion, the moisture result is more dependent on the initial state.

3. After an adjustment if SmartCal values are still outside the control limits, is my instrument defective?

If the Moisture Analyzer is adjusted correctly (6.1 "Adjustment of the Moisture Analyzer") and all other reasons (5.2 "Potential reasons for outlying values") can be excluded, the Moisture Analyzer results should be within the control limits.

Further clarification:

- Is the temperature calibration kit showing the correct temperature?
- Call a METTLER TOLEDO Service Technician

4. Why do the SmartCal results vary more than results from my real sample?

The reference substance is very sensitive to drying temperature. This attribute makes it suitable for a performance check which includes the drying temperature (see 2. "Working Principle").

5. Why is the test substance not fully dried during the performance check?

A reliable and repeatable performance check can be performed in just 10 minutes without the need for complete drying of the test substance.

6. How are the control limits determined?

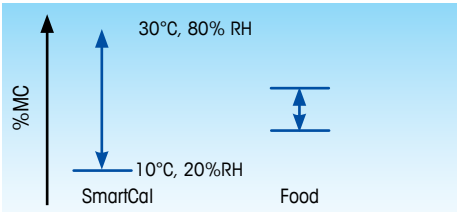
Multiple measurements with all SmartCal drying temperatures were performed on a variety of Halogen Moisture Analyzers. The mean value of the range corresponds to the mean value of all product lines of METTLER TOLEDO Halogen Moisture Analyzers.

7. Can I use SmartCal for other moisture analyzers?

In principle it is possible to use SmartCal for other instruments besides METTLER TOLEDO Halogen Moisture Analyzers (but not for microwave moisture analyzers). However, the moisture results will be different from our control limits due to other constructions or technologies. The control limits and normalization values provided are only valid for properly installed METTLER TOLEDO Halogen Moisture Analyzers.

8. Do measurements with my samples need to be normalized to ambient conditions?

Generally, typical samples are not as sensitive as SmartCal to ambient conditions. As seen in the Figure, SmartCal shows a much wider range compared to typical substances. For this reason, measurements with real samples usually do not need to be normalized.



9. Can I use the steel sample pan?

The aluminum sample pan is recommended. However, the 6mm steel sample pan can also be used. The same type of sample pan should be used consistently.

www.mt.com/smartcal
For more information

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Printed in Switzerland 30005934a