

The New Mark 3 Moisture Analyzer from Sartorius Mechatronics **Setting a new standard in performance**

As the next generation of the popular Mark 2, the design strategy was to optimize all of the systems and features affecting performance. The resultant Mark 3 is truly an enhanced moisture analyzer in terms of instrument reliability and accuracy of results. The concept was simple, reduce the uncertainties in the analyzer through better design and control of the variables of heater control and balance accuracy.

The primary components of the Mark 3 include: an integral state-of-the-art monolithic electronic balance with thermal isolation, an infrared quartz cylinder heating system with controlled airflow characteristics to minimize detrimental weighing effects on the balance, and a Motorola *Coldfire*[®] microprocessor and associated electronic circuitry that provides the basis of an intelligent platform for sophisticated digital electronic control and communication support for serial, USB and Ethernet functionality.

The first two of these is described in detail below:

Electronic Balance

The heart of the Mark 3 is the monolithic balance that is precision milled on an automated CNC machines from a single block of aerospace grade aluminum alloy. This is in contrast to the older balance design of the Mark 2. Prior to the Mark 3 the previous generation of balance was comprised of approximately 200 components that must be assembled by trained craftsmen. There isn't a tolerance stack-up or potential of human error in assembly with the new Mark 3. Also, the earlier balance versions, being comprised of various metals were sensitive to temperature fluctuations. The differing metals had dissimilar expansion and contraction co-efficients. The result of this was balance drift. The Mark 3 is not affected by temperature fluctuations because it is constructed of a single monolithic metal. With this Mark 3 balance design there is near zero drift under varying temperatures. Also, the Mark 3 is not affected by hysteresis due to its monolithic state of the art construction and design.

The way to audit the balance in previous moisture analyzers was by manual calibration with a fixed weight. Potential errors in this balance check exist with the user following proper procedures in applying and removing the weight. The Mark 3 has built-in calibration weights with associated software that allows for a complete auto-balance calibration. This automated routine not only calibrates the balance but also verifies linearity, repeatability and acceptable tolerances for drift. Results of this auto-calibration are also printed out for hard copy documentation and stored in memory within the Mark 3. No other moisture analyzer has this feature!

The monolithic design of the Mark 3's balance creates a moisture analysis instrument that has nearly zero drift. Instead of hours to warm-up, the Mark 3 requires only 15 minutes or less when first turned-on. The Mark 3 balance has a 100gram capacity and is readable to 0.0001g. The balance contains an internal calibration weight mechanism to automatic calibration. A unique arm extends off the balance mechanics that holds the pan support receiver. The receiver is

designed to take shock in both a lateral and downward direction to prevent breakage of the balance.

Heating

The Mark 3 has an open design configured to direct convective currents up and out of the chamber area, like a chimney. Potentially volatile vapors cannot build up in the chamber area. The sample itself is surrounded by a breeze shield, which isolates the sample from the rising air currents. The result of this design is accurate weighing by the balance during a test. By design, the Mark 3 dome area on top of the heater area is significantly cooled by the addition of heat dissipating panels above the Mark 3's heater. The Mark 3 has a molded heater top with louvers that disperses the heat instead of retaining thermal energy. A side benefit to the Mark 3's heater configuration is a more even heating of the sample. Also, with the thermal vectoring of the dissipated heat from the top of the Mark 3 the instrument is not sensitive to or affected by external air currents directed downward toward the analyzer.

The temperature sensor within the Mark 3 is made of platinum, and is known as a resistive temperature device (RTD). The Mark 3 utilizes a modern ceramic-based potting compound that provides superior performance, especially at higher temperatures. The Mark 3 utilizes an adaptive algorithm with a pulse width modulation (PWM) and a dynamic constant feedback loop. This programming advance means that when the instrument is cool prior to performing a test you no longer have the problem of artificially high moisture values or potentially burning of the sample on some materials on that first test. No longer do you need to discard your first test of the day!

The Mark 3's balance is not affected by thermal variations. Therefore, elevated standby temperatures are not critical to the performance of the balance and resultant test. By the design of the heating system, testing of all types of materials including temperature sensitive samples can be performed on the Mark 3.

Many of these chamber design characteristics have been improved over the previous generation Mark 2. Air currents have been studied and are directed away from under the pan that can create a negative effect called "pan-lift". The sample pan itself has been changed from stainless steel to aluminum to minimize potentially negative magnetic effects on the balance. The Mark 3 heater module includes a hydraulic piston hinge support mechanism for smoother opening and closing and an updated latch mechanism. The Mark 3 cover is injection molded to tighter tolerance specifications, as well as a new design under the sample pan to collect spilled sample (liquid or powder) to contain and eliminate any contamination to the balance area.

Electronic and Software Design Features

- Universal power supply for regulating varying line voltages.
- Integral 40 column thermal printer
- Internal temperature adjustment with the use of an optional external adjustment bowl
- Quarter VGA screen
- Membrane style keypad
- USB port for software up-grades
- Serial port for drying procedure loading or serial interface communications
- Ethernet port for interface to a network. Future applications will include remote diagnostics, temperature calibration, instrument certification, and remote evaluation while testing samples
- Multi-module control from a single control module (up to 4 heating modules)

In summary, the Mark 3 has been optimized to increase the certainty of accurate results. In addition to the above-mentioned Mark 3 design features, one further design objective was to maintain backwards compatibility of over 10,000 drying programs for thousands of different types of samples generated on the Mark 3's two predecessor analyzers. This objective posed the largest challenge to the project because of the constraint in being able to use any of these procedures without diminishing a sample test's speed, precision and accuracy. Through extensive testing in both our laboratory and in new installations, on all different types of samples we have shown that Mark 1, Omni 1 and Mark 2 drying procedures can be used without any alteration on the Mark 3. The only difference noted was better accuracy and precision with the Mark 3. Also, drying programs can be downloaded directly from a Mark 2 via the export routine and into the Mark 3 via a download cable, and in moments one can be testing with the Mark 3.

With certainty designed into the new Sartorius Mechatronics Instrument Mark 3 Moisture Analyzer you can be assured you are getting the most accurate and reliable moisture analyzer available. In addition, the strongest team of sales consultants and technical resources specifically focused on solving your moisture problems will support you. For more information contact Sartorius Mechatronics at 800 835-3211.

Sartorius Mechatronics Corporation

6542 Fig St.
Arvada, Colorado 80004

Phone: (303) 876-5390

Toll Free: (800) 835-3211

Fax: (631) 253-5263

Customer Service E-Mail: info@sartorius-omnimark.com