

MOISTURE MONITORING AND CONTROL OPTIONS: FINDING THE RIGHT SYSTEM FOR YOUR GIN

**Mark Gentry
Samuel Jackson, Inc
Lubbock, TX**

The need for moisture management at a gin is well documented. From the module feeder to the press, conditioning cotton to the proper moisture level for each processing stage yields benefits to the grower, gin, and consuming mill. There should be no doubt that every gin can benefit from moisture monitoring and control. There should also be no doubt that the layout, operators, size and needs of every gin is different and that there is not a one size fits all solution.

To accommodate the variety of needs from each gin, the Moisture Mirror line of moisture monitoring and control products were designed to be both flexible and scalable. This approach keeps the entry-level systems at an affordable level for smaller gins, while offering larger gins an almost unlimited choice of options. The following guide outlines options that are currently available on the Moisture Mirror product line, including the ability to integrate with other manufacturer's sensors and systems. Customizing a moisture monitoring and control system for your gin is as easy as exploring your options and picking the ones that are of most importance to you and your operation.

The Moisture Mirror System

The Moisture Mirror System platform requires a base unit and allows you to connect your choice of inputs and outputs. Its flexible configuration allows it to connect to a variety of cotton conditioning systems, including drying temperatures, conditioning hoppers, Moisture Trackers and Steamrollers. By selecting the options and benefits that are most important to you, you can maximize your return on investment and optimize your cotton conditioning system(s).

Moisture Mirror Base Unit

The Moisture Mirror Base Unit is somewhat of the "brain center" of the entire system. From a nuts and bolts perspective, its main components are a programmable logic controller (PLC) and a 6-inch color touch-screen operator interface. These devices are the communication avenues between sensors, conditioning equipment, and the operator. The PLC and associated components are contained in a fiberglass enclosure, which is typically mounted in or beside the ginner's console. The touch-screen display mounts on the console face, giving the operator one centralized place to refer to for a moisture summary.

But the true appreciation of the Moisture Mirror Base Unit goes far beyond the individual components. The best electronic components in the world are useless without a creative force that tells them how to work. Over fifty years of moisture control experience and input from ginner's from literally hundreds of gins have been distilled into the software, making it a practical and effective control as well as operator friendly. By itself, the Base Unit does nothing. To make it beneficial, you must provide it with useful information via sensors (inputs). Deciding which input options to utilize is entirely up to you.

Moisture Mirror Input Options

The Moisture Mirror has seven analog (4-20 mA) and 3 discrete (120 VAC) inputs. Some of the inputs are tied to sensors, which provide the Moisture Mirror and user with details about cotton as it passes through the gin. The other inputs are used to gather information to help control some outputs (see more in the next section).

As the name of the system implies, the primary function is moisture control so the primary inputs are moisture readings. Moisture input options are for the incoming moisture, after-drying moisture, and bale moisture. Each of these inputs can be scaled for Samuel Jackson manufactured sensors or third party sensors that produce a linear, 4-20 mA signal.

Incoming sensors are used to measure the moisture of cotton as it enters the gin and are available for a variety of applications including Hot Box inlet doors, belt conveyors, feed control bins, and pass-through hoppers above vacuums. This sensor's information can be used to automatically set the drying system temperatures. After-drying sensors are typically located in a live-overflow for the best results. However, in the absence of a live-overflow, the after-drying sensor can be located in the change bale hopper provided that Conditioning Hoppers aren't being used (deeper hoppers yield better results). Samuel Jackson offers bale moisture sensors that can be integrated into Steamrollers and Moisture Trackers, as well as a Waffle Iron sensor if classing samples are taken at the gin. To help you decide which sensors are right for you see Table 1.

In addition to moisture readings, the Moisture Mirror can also monitor the flow of cotton into your gin by measuring the actual power consumed by the motors of your inclines and/or module feeder dispersing cylinders. These options are referred to as Flow Analyzers. Three available Flow Analyzers inputs help your ginner regulate the feed rate of incoming cotton and can signal potential problems before choke-ups begin. On split pre-cleaning systems, it also offers the benefit of helping obtain a good cotton split that promotes better cleaning and drying.

The other inputs are related to heater and Humidaire control. One of the discrete inputs is an optional “Idle Heaters” switch that, when used with the heater control, will force the heaters to idle to conserve fuel. Other inputs monitor cotton flow, Humidaire flame status, and moist air temperature as variables in the algorithm that controls the Humidaire output.

Moisture Mirror Output Options

The information from the sensors discussed above are collected and displayed on the touch-screen. Results are shown in a variety of forms including a summary screen, detailed sensor screens, and a 24-hour summary graph. Just providing this information to your ginner can generate benefits, but this information can also be used to control a variety of outputs and increased automation. The Moisture Mirror offers five analog (4-20 mA) and three discrete (120 VAC) outputs.

The most popular of these outputs is the drying system temperature control output because virtually every modern gin has a drying system and a related concern for fuel costs. Effective automatic drying temperature control allows the operators to gin at lower temperatures with confidence, thereby saving fuel and protecting fiber quality. The operator is provided with limited control that can bias the temperature up or down by adjusting the Drying System Index, allowing him to make minor adjustments. Because the system responds quickly to wet cotton, it allows the ginner to operate at lower temperatures without penalty. Users report fuel savings from 30-50%. Using this output requires an incoming moisture sensor and digital temperature controls capable of accepting a 4-20 mA remote set point signal.

A popular output choice for Steamroller users (and now available to Moisture Tracker users) is the automatic Humidaire control. This output requires a bale moisture sensor, which is easily integrated into the moist air applicator. The control algorithm compares the measured lint moisture content with a user-entered target value and adjusts the water set point accordingly. The result is more consistent bale moisture and less demand on the operator.

Three of the outputs are “repeater” outputs for the moisture readings. The incoming, after-drying, and bale moisture inputs each have a corresponding output. These outputs can be used by other systems, including data collection systems or for secondary displays.

The remaining outputs are discrete outputs and are user programmable to perform special functions. For instance, the Conditioning Hopper Valve Override can automatically close moist air valves when wet cotton enters the gin. Other outputs are tied to the incoming moisture and flow analyzer. These contacts can be programmed to open or close at user-determined levels. Examples of potential uses for these outputs are to flash a warning light or to slow/pause the incoming feed rate.

Moisture Mirror Benefit Summary

The Moisture Mirror system offers several gin-level benefits. The primary benefits are listed below.

- Provides a centralized place to manage all moisture systems.
- Saves drying system fuel, typically from 30-50%.
- Automates the control of cotton conditioning tools such as Heaters, Humidaires, and Conditioning Hoppers.
- 24-Hour graph keeps a watchful eye on moisture(s) around the clock.
- Easy to operate and ginner-friendly means that it is more likely to be utilized fully.
- Easy and fast installation.
- Flexible configuration allows the system to be customized to both budget and performance requirements.
- Scalable platform allows it to grow with your gin.

The Moisture Mirror II System

The Moisture Mirror was beta-tested in 2001 and made widely available in 2002. It enjoyed immediate success and is currently installed in over 60 gins. While all of the users enjoyed its powerful features, some requested new features to be added. Rather than add these special options to all of the Moisture Mirrors, which would require an increase in price, an upgrade option was made available by allowing users to choose the level of performance they wanted. In 2003 this upgrade was made available under the name Moisture Mirror II.

Moisture Mirror II Base Unit Upgrade

The main upgrade components are the addition of a network back bone and the replacement of the 6-inch touch screen with a ten-inch touch screen. Existing Moisture Mirrors can be easily upgraded to a Moisture Mirror II or a new Moisture Mirror II Base Unit can be supplied initially. The ability to upgrade at any time allows you to add Moisture Mirror product line features whenever you are ready for them.

The 10-inch touch screen not only provides a bigger, more easily read display, but it also features the addition of several useful and helpful screens. For example the Cash Register Screen keeps a running tally of the per bale benefit of moisture restoration. This information is a great way to show the value the gin adds to each customer’s cotton.

The addition of the network backbone increases the scalability of the product and allows features such as the addition of extra touch screens (i.e. one for the gin office), print ability, and control of the Samuel Jackson 1400 series products.

Moisture Mirror II Inputs

The Moisture Mirror II offers all of the input options on the Moisture Mirror plus several others.

A common request was for a “Bales per Hour” indicator. This new feature was easily accomplished by incorporating a bale-made input. A signal from the press or bale-handling system can signal a new bale and an average based on both time and the past three bales is used to provide a valid bales per hour production rate.

Another innovation was the addition of a Drying System Index set point input. On the Moisture Mirror, the Drying System Index is set by the operator. The Moisture Mirror II allows the Index to be controlled by an outside source. An example application for this feature pertains to customers that also employ the Intelligin System from Zellweger-Uster. Instead of allowing the Intelligin to control the temperatures directly, it’s possible to let it adjust the Drying System Index and let the Moisture Mirror II dictate the temperatures, allowing the drying system to respond faster to wet incoming cotton.

Finally, the Moisture Mirror II can be networked to the 1400 series Humidaires and Heaters, making it possible to view operating statistics from these devices. This includes operating temperatures, water watch data, alarms, and errors. When combined with these products, the Moisture Mirror II offers true single location control of multiple conditioning systems, making managing these systems easier and saving console space.

Moisture Mirror II Outputs

Just like the inputs, the Moisture Mirror II offers all of the output options offered by the Moisture Mirror plus additional options.

To start with, the connectivity to the 1400 series products serves as a series of outputs. The Moisture Mirror II can be used to set temperatures and operate these products. Multiple products can be controlled from one touch-screen, meaning that multiple remote controls do not need to be purchased.

The number one request after the introduction of the Moisture Mirror was the ability to print the results, so that became the number one priority of the Moisture Mirror II. With the addition of the printer option, users can have summary reports automatically printed at regular timed intervals or with each bale. Average, minimums, and maximums are reported for incoming moisture, after-drying moisture, bale moisture, drying system index, and bale moisture target. Figure x shows an example of this report.

Another option enabled by a networked backbone is the ability to add multiple touch screens. With a network cable or a wireless bridge touch screens can be added anywhere in the gin or the gin office. These extra screens can make it easier for managers to keep an eye on the gin while working from their desk, provide a powerful marketing tool for prospective gin customers, or allow operators to dedicate individual screens for specific use.

Moisture Mirror II Benefit Summary

In addition to the benefits offered by the Moisture Mirror, the Moisture Mirror II also offers the following benefits:

- The ability to print data reports
- A bigger touch-screen that is easier to read and has more pages
- Connectivity to 1400 series Heaters and Humidaire Units
- Optional connectivity to Intelligin for faster response of drying systems
- “Cash Register Screen” prominently displays the benefit of weight regain from moisture restoration systems
- Builds on Moisture Mirror platform so that upgrades can be made without losing previous investment
- Network backbone makes future expansion easy.

S.A.M. (System Analyzer & Monitor)

S.A.M.’s roots date back to 1998, but it was integrated into the Moisture Mirror line and became a standard product in 2003. Originally it was built as a one-of-a-kind custom system for Jones County Cotton Gin in Trenton, NC. The system collected moisture, temperature, production, and ambient condition data for each bale ginned. This data was stored in a database for permanent storage and allowed the results to be viewed, printed, or analyzed at any time. In addition to long term data collection, a 56 kbps modem allowed remote connectivity which allowed engineers to troubleshoot conditioning systems in real-time from anywhere with a telephone line.

The data collected by the first system was very valuable and used to implement many improvements. The system itself, however, was an ad-hoc design that used a lot of on-hand components and there were several weak links in the chain. Proc-

essing the large volumes of data at the fast ginning rate was the biggest obstacle faced by the first system. The computer was prone to crashing after it had been running for several days. As the database got bigger, the interval in between crashes shortened. From 1998 to 2002 improvements were made, but the system still suffered from downtime.

The weaknesses in the system were resolved in 2003 due to several factors. First, the ad-hoc design was scrapped and the system was redesigned with an industrial hardened emphasis. Another improvement was the new design was built upon the proven platform of the Moisture Mirror II, which made its implementation easier by allowing a building block approach. Next, the system was standardized and made a part of the normal product line, which allowed it more development time and the benefits of better documentation and easier troubleshooting. Finally, the system was made internet ready, which allowed the system to be accessed by its users and designers from anywhere in the world with an internet connection at speeds from 128kbps. With the new robust design the system became known under its new name, S.A.M.

S.A.M. Base Hardware

As stated earlier, S.A.M. is built on the Moisture Mirror platform. A Moisture Mirror II with the Analog Data Concentrator (ADC) option is required. A single Moisture Mirror II and ADC option can support up to 8 heaters and 4 Humidaires Units, making it large enough for most gins. Gins with two presses, and thus two independent bale moisture readings, require two Moisture Mirror II packages.

In addition to the above, S.A.M. comes with a networked computer and color printer in a pedestal style enclosure that is designed to be located in the gin office. A bar code scanner can be supplied and used to record either a bale number or a module number with the collected data points. The scanner can be located at the console or at the press. A high-speed internet connection, such as DSL, cable, or ISDN, is required.

S.A.M. Inputs

Since it ties into the Moisture Mirror II, all of those inputs are available to S.A.M. In addition, it also monitors and records the temperatures of the gin's cotton conditioning equipment. In total S.A.M. can handle 50 channels of data including before and after mix point temperatures of up to 8 heaters, the air and water temperature of up to 4 Humidaires, 3 moisture readings, 3 Flow Analyzer readings, ambient temperature, and ambient relative humidity. Recorded non-analog inputs are bale or module number, bales per hour, bale moisture target setting, and drying index operator setting.

S.A.M. Outputs

S.A.M. can utilize all of the output options offered by the Moisture Mirror II. Beyond that, its main function is a data collector and monitor. Since the data is ultimately collected and stored by a computer, there are several methods of outputting data.

The data collected is on continuous display on the S.A.M. computer. An easy to navigate display allows operators to zoom into several layers of detail or watch a summary display of real-time data. Internet-accessibility allows the same data to be viewed over a web page at any computer on the internet. For security reasons a system username and password are required when viewing data over the internet.

S.A.M.'s printer can be configured to print shift reports at regular intervals. These reports provide a great synopsis of the shift's production and the operation of the cotton conditioning systems. Manager's can use this information to verify how the cotton was handled and to see any downtime that occurred over the shift. If module numbers are being tracked, module reports can also be automatically printed. These reports are a great tool for demonstrating the value of cotton conditioning to growers and showing them the impact that module moisture has on production and quality. Furthermore, a wide variety of reports on demand can be generated at any time, allowing historical data to be analyzed when ever needed.

If you want to share data with information collected from other systems, data files can be exported in a variety of formats. Since the data from S.A.M. can be listed by either bale number or module number, it can easily be correlated to other files such as USDA classing data, inventory systems, and gin-based classing systems. Combined together, the information from these systems can tell a bale's history. Variety, turnout, moistures, gin processing data, grade, weight, and loan value can all be linked for each bale. This information can be used by both the grower and the gin to improve management practices and make informed decisions to maximize profitability.

S.A.M. Benefit Summary

S.A.M. offers all of the benefits of the Moisture Mirror and Moisture Mirror II. Additionally, having recorded processing data for every bale has many valuable benefits, including the ones listed below.

- Permanent data storage allows analysis during and after the season, as well as year to year
- Documents the conditions the cotton is ginned under
- Easy data retrieval from a variety of sources

- Monitors cotton conditioning system performance
- Monitors ginner performance
- Training tool for personnel
- Great marketing tool for existing and potential gin customers
- Useful in explaining grades to customers
- Makes incentive programs for bringing in good modules possible (through rebates or penalties based on module moisture)
- Valuable research tool to evaluate improvements and techniques to improve quality and value

Summary

Moisture management benefits all gins, but not all gins are the same. The Moisture Mirror product line offers a variety of options and a building–block architecture that allows you to prioritize your needs with the comfort of knowing the system you choose can grow with your operation.

For more help in determining which moisture monitoring and control system is right for you, refer to the tables in the appendix and visit the Samuel Jackson website at www.samjackson.com.

Table 1. Moisture Mirror Sensor Options.

Type	Name	Requirements and Notes
Incoming	Hot Box Inlet Gate Moisture Sensor	Requires a Samuel Jackson Hot Box II style hot box. Does not require additional belt space.
Incoming	Sled II	Requires a belt conveyor and 30 inches of belt space.
Incoming	Feed Bin Sensor	Requires a feed bin where cotton stacks up or a spot on a transition wall where cotton hits regularly.
After-drying	Overflow Sensor	Requires a live overflow.
After-drying	Change Bale Hopper	Not compatible with Conditioning Hoppers.
Bale	Platen Sensor	Requires a Steamroller.
Bale	Moisture Tracker	Standard equipment on Moisture Trackers.
Bale	Waffle Iron	Tests the moisture in the classing sample. Depends on labor to test each bale.
Any	Third-party sensors	Review manufacturer’s specs for details. Must provide a linear 4-20 mA signal.

Table 2. Moisture Mirror System Features.

Available Features	Moisture Mirror	Moisture Mirror II	S.A.M.
Incoming Moisture Option	Yes	Yes	Yes
After-Drying Moisture Option	Yes	Yes	Yes
Bale Moisture Option	Yes	Yes	Yes
Automatic Heater Control	Yes	Yes	Yes
Automatic Humidaira Control	Yes	Yes	Yes
Conditioning Hopper Valve Override	Yes	Yes	Yes
24-Hour Moisture Graph	Yes	Yes	Yes
Flow Analyzer Option	Yes	Yes	Yes
Saves fuel	Yes	Yes	Yes
Scalable for future growth	Yes	Yes	Yes
Easy software updates	Yes	Yes	Yes
10" Touch screen(s)	No	Yes	Yes
Ability to add extra screens	No	Yes	Yes
Printer option	No	Yes	Yes
Cash Register Screen	No	Yes	Yes
Networked backbone	No	Yes	Yes
1400 Series Network Compatible	No	Yes	Yes
Remote Drying System Index Option	No	Yes	Yes
Bale per hour register	No	Yes	Yes
Logs moisture and temperature data into permanent storage	No	No	Yes
Data available in multiple formats	No	No	Yes
Captures bale or module number	No	No	Yes
Automatic shift reports	No	No	Yes
Automatic module reports	No	No	Yes
Internet accessible	No	No	Yes
Normal price range	\$5,200 – 20,000	\$12,500 – 26,000	\$26,000 – 80,000