



TSP-M Mini-Strip Almen Gage

Instruction Manual



56790 Magnetic Drive, Mishawaka, Indiana 46545 USA • 1-800-832-5653 or (574)256-5001 • www.electronics-inc.com

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Description

The model TSP-M Almen Gage is manufactured to the specifications of *SAE J442 Test Strip, Holder and Gage for Shot Peening*. It is a precision device used for measuring the curvature of a metal test coupon called an Almen mini-strip. It has a calibrated electronic digital indicator with a low-force spindle spring to provide highly accurate and repeatable measurements. This gage will provide many years of trouble-free service if properly maintained. The gage should be calibrated, the indicator performance should be tested, and the support platform checked for wear annually or more frequently if conditions warrant.

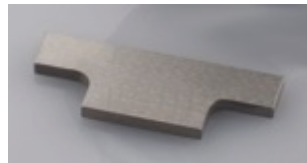
The gage comes with two (2) batteries with a life expectancy of at least one (1) year. The batteries can be easily replaced without loss of calibration.

General Information

A special Zero Block (included) will set the digital zero reference.



The magnetic base secures the Zero Block for easy access



The Zero Block



The Zero Block on the magnetic base

Environment

The indicator is built to withstand severe use. It has a gasket-sealed case, a hard crystal display window and a durable stem assembly to resist most dust and fluids. The gage should never be immersed in liquid as this will cause damage to the unit. The seals and boots should be regularly inspected to prevent contamination. The dust cap for the electronic 4-pin connector should always be in place whenever an output cable is not attached. This will prevent damage to the connector. Please respect the recommended temperature ranges shown below.

	Temperature Range	
Storage:	4°F - 140°F	-15.5°C – 60°C
Operation:	60°F - 90°F	15.5°C - 32°C

Control Features

Three red control buttons on the display perform these user functions:

- ZERO/ON: Turns the unit “ON”. It can also be used to set the Spindle Starting Position. See the “Trouble Shooting the Model TSP-M” section for more information on this feature.
- M/OFF: This button, when pushed and held for three (3) seconds, turns the unit “OFF”.
- inch/mm: Allows the selection of the display in inches or millimeters.



Red control buttons

Quick Switch From MM to Inch

SAE J442 requires Almen gage indicators to have a resolution of 0.001 mm; therefore, the TSP-M Almen Gage is factory set to display 0.000 mm, with a 0.001 mm resolution.

Pressing the inch/mm button, changing measurement units from millimeters to inches, results in a five (5) digit display (0.00000 inch) with a resolution of 0.00005 inch.

If a display of only four (4) digits (0.0000) in inches is preferred, use the following steps to reprogram the indicator.

1. Turn on the TSP-M by pressing ZERO/ON.
2. Press inch/mm to change the scale to inches
3. Press the M/OFF and inch/mm buttons at the same time (M1 will appear on the bottom left of the display)
4. Press M/OFF four (4) times
5. Press inch/mm six (6) times until the display shows 0.0001
6. Press M/OFF to exit the programming mode

Factory Default Settings

Indicator Polarity

The indicator should be in the Reverse Measurement Direction mode as indicated by “R” at the bottom of the display. This allows for positive numbers to be shown on the display as the indicator extends into the concave arc of the Almen strip. If the “R” is not shown, see the “Trouble Shooting the Model TSP-M” section to return to the Reverse Measurement Direction Mode.

Resolution

Metric mode resolution is factory set to three (3) decimal places (e.g., 0.600 mm). If the inch mode is required, the resolution will be set at five (5) places (e.g., 0.00240 inch) by default. See the “Quick Switch from MM to Inch” section above to change the resolution to only four (4) places.

Measuring the Pre-Bow of a New (Unpeened) Almen Strip

The following steps should be performed on the standard Almen strips and the mini-strips.

1. Push the ZERO/ON button to turn the gage "ON".
2. Place the Zero Block on the gage with the indicator tip touching the small side of the block. Push the ZERO/ON button to achieve 0.000 mm in the display.
3. Place a new (unpeened) Almen strip onto the measurement position. Be sure the strip touches the back posts and is centered between the end posts.
4. Read and record the pre-bow (also called flatness).
5. Turn the strip over and measure the opposite side. If the reading from either side exceeds the specification value, discard the strip. (See Table 1 for common examples of acceptable pre-bow).



The small side of the Zero Block is placed on the gage. The reading is 0.000 mm.

An unpeened mini-strip placed on the mini-strip gage.



An unpeened Standard Almen strip placed on the #2 Almen gage.



Table 1. Examples of common industry Almen strip requirements for maximum pre-bow of unpeened strip			
Specification	Grade	mm	Inch
AMS2432, Shot Peening, Computer Monitored	A1-S™, N1-S™	±0.013	±0.0005
AMS2430, Shot Peening	A-1™, N-1™	±0.025	±0.0010
J442, Test Strip, Holder and Gage for Shot Peening	A-1™, N-1™	±0.025	±0.0010
MIL-S-13165 Shot Peening of Metals (Canceled)	A-2™, N-2™	±0.038	±0.0015

Measuring the Arc Height of a Peened Almen Strip

The following steps should be performed on the standard Almen strips and the mini-strips.

Step One – Zero the Almen Gage

1. Push the ZERO/ON button to turn the gage “ON”.
2. Place the Zero Block on the gage with the indicator tip touching the small side. Push the ZERO/ON button to achieve 0.000 mm in the display.

Step Two – Perform Pre-Bow Compensation

If your shot peening procedure, such as process development or system capability studies, requires higher intensity accuracy, pre-bow compensation may be used. This technique can provide an additional reduction in process uncertainty. A pre-bow compensation ensures that only the net difference in arc height of a peened Almen strip is plotted on a saturation curve. To perform pre-bow compensation:

1. Zero the Almen gage and then place the unpeened Almen strip on the gage and record its value.
 2. Be sure to note if value is positive or negative and write the value on the opposite side of the strip.
 3. Do not peen the side of the Almen strip with your handwritten note.
 4. A positive number is subtracted from the arc height reading after the strip has been peened. A negative number is added to the arc height reading after the strip has been peened.
- For example:
- a) If the pre-bow is +2 and the arc height reading is 10, the adjusted arc height reading is 8
 - b) If the pre-bow is -2 and the arc height reading is 10, the adjusted arc height reading is 12

In summary, most peening applications can tolerate the SAE J442 pre-bow bias of ± 0.001 " for N and A strips. If this tolerance level is too high, you can apply the pre-bow compensation discussed above.

Step Three – Measure the Arc Height

1. Place the peened Almen strip onto the measurement position with the indicator tip touching the non-peened side (concave side) of the strip. Record the value of the arc height shown in the display or, if using pre-bow compensation, the arc height shown in the display with the pre-bow compensation applied.
2. Remove the strip and place it once again on the gage. Do this three (3) times to assure an accurate reading.
3. When finished, push and hold the M/OFF button for three (3) seconds to turn the gage “OFF”. (The gage automatically turns “OFF” if it is not active for 15 minutes.)



Peened mini-strip placed on the mini-strip gage. The reading is 0.199 mm.



Peened standard Almen strip placed on the #2 Almen gage.

Changing the Batteries

The Almen gage has a battery tray that holds two (2) CR2450 lithium batteries. A warning message appears in the gage's display when the batteries need to be replaced.



Battery Low message

To change the batteries:

Step 1. Using a small flat-blade screwdriver, carefully slide the blade into the opening and release the battery holder. Do **NOT** remove digital indicator from the gage.



Do **NOT** remove the digital indicator from the gage

Step 2. Once the battery holder is unlocked, grasp it with your fingers and pull the battery holder out.



The batteries are on the underside of the tray.



Step 3. Remove the expired batteries and place the new batteries positive side up in the tray. (The current Almen gage set-up and calibration information are retained when the batteries are replaced.) Place the battery holder in the battery compartment and push it in until it locks into position.



Calibration

Periodic calibration of the Almen gage is important to assure process repeatability and accuracy. The gage's digital indicator should be removed and calibrated annually or sooner if it appears to be damaged or inaccurate. Use of a standard calibration stand as shown is recommended or you may return the gage to Electronics Incorporated for service.

The digital indicator should be re-installed with the Zero Block in place and the physical position of the indicator adjusted on the frame so that it is near True Spindle Zero ± 0.025 mm. This assures that the indicator is in the preferred accuracy range. See the section titled "Checking or Setting the Spindle Starting Position" for more information.



Federal Calibration Stand

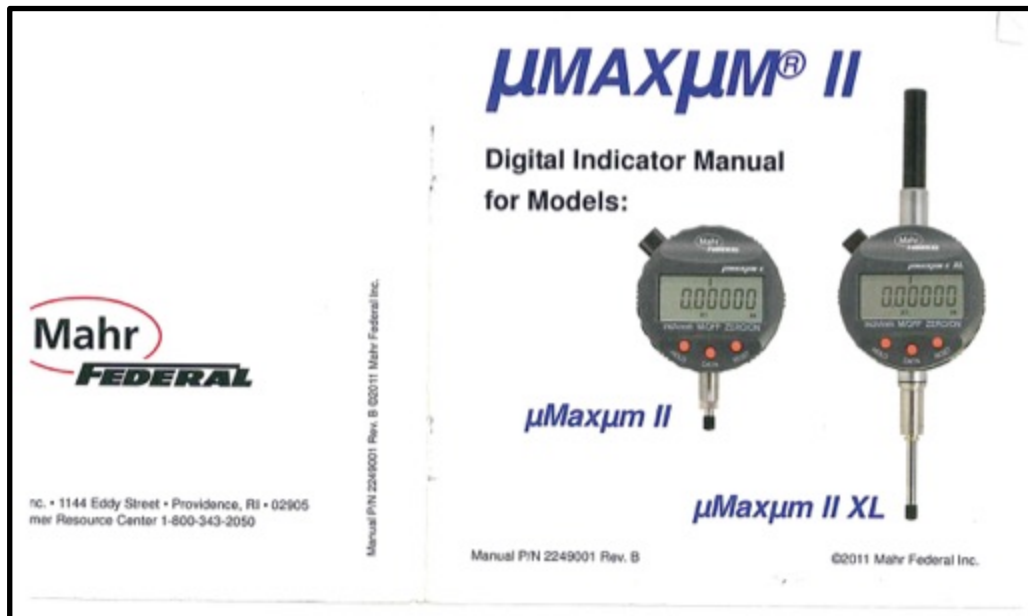
Inspection of the Gage Head

Examine the condition of the back post for wear, which may interfere with proper seating of the strip onto the platform.



Digital Indicator Instruction Manual Information

For additional information on the digital indicator, please refer to the Mahr Federal Incorporated Digital Indicator Manual included with the gage. If missing, the manual is available from Electronics Inc.



Cover page of the instruction manual for the Digital Indicator

Computer Interface Device Accessory

Entering multiple measurements is quick and easy with the Computer Interface Device. The device plugs into a computer's USB port and pulls the value displayed on the Electronics Incorporated Almen Gage directly into a computer program (Excel, Word, or similar software). The Computer Interface Device eliminates data entry errors and accelerates the measurement process. A push-button or foot switch controls the device. There are no power requirements as the device is powered from the USB port and there are no drivers to load.



*The Computer Interface Device
(part number 999144)
(Does not include an Almen gage)*

Trouble Shooting the Model TSP-M

If the TSP-M Almen Gage indicator display is flashing, or if the gage will not zero, or the resolution needs to be changed, the following instructions will return the gage back to its factory default settings and remedy these conditions. Perform every step—one through six—in sequence until the problem is resolved. If more assistance is needed, please call Electronics Incorporated Customer Service Department at 1-800-832-5653 (USA and Canada) or (574) 256-5001.

Step One

- Press M/OFF and the inch/mm button at the same time. "**M1**" will appear on the screen.
- If the "R" is not on the bottom left side of the screen, press ZERO/ON button until the "R" is on the screen.
- If the "X1" is not on the bottom center of the screen, press the inch/mm button until "X1" is selected.

Step Two

Press M/OFF button. "**M2**" will appear on the screen and it should read **000.0000**.

- If "-" precedes the digits, press the ZERO/ON button to remove it.
- Press the inch/mm button to move the cursor over to the first non-zero digit to be changed.
- Press the ZERO/ON button repeatedly to toggle through numbers until "0" is displayed. Repeat for other digits not at "0."

Step Three

Press M/OFF button. "**M12**" will appear on the screen and it should read **000.0000**.

- If "-" precedes the digits, press the ZERO/ON button to remove it.
- Press the inch/mm button to move a cursor over to the first non-zero digit to be changed.
- Press the ZERO/ON button repeatedly to toggle through numbers until "0" is displayed. Repeat for other digits not at "0."

Step Four

Press M/OFF button. "**M23**" will appear on the screen and it should read **000.0000**.

- If "-" precedes the digits, press the ZERO/ON to remove it.
- Press the inch/mm button to move a cursor over to the first non-zero digit to be changed.
- Press the ZERO/ON button repeatedly to toggle through numbers until "0" is displayed. Repeat for other digits not at "0."

Step Five

- Press M/OFF button. "**M13**" will appear on the screen. This is the Digital Resolution Mode screen.
- When using the mm mode – press the inch/mm button repeatedly to select **0.001**.
- When using the inch mode – press the inch/mm button repeatedly to select **0.0001**.

Step Six

- Press M/OFF button - the gage will be in run mode.
- Place the flat side of the curved Zero block on top of gage and press the ZERO/ON button.
- The indicator will read 0.000 mm if in metric mode or 0.0000 if in English mode.
- The bottom of the screen will read "**R X1 mm**" or "**R X1 in**".

Step Seven

Check the Spindle Starting Position to ensure it is in the preferred range. See the next section for directions on checking or setting the Spindle Starting Position.

Checking or Setting the Spindle Starting Position

To evaluate the Spindle Starting Position, place the Zero Block on the gage and enter the gage into True Spindle Mode by pressing and holding the ZERO/ON button for three (3) seconds (the "X1" will disappear when in True Spindle Mode). The value of the Spindle Starting Position should be set to 0.000 mm + 0.025 mm (0.0000 inch + 0.0010 inch). If the Spindle Starting Position is out of tolerance, reposition the indicator on the frame using the instructions below or call Electronics Incorporated or an Authorized Distributor for assistance.

Instructions:

Be sure the zero indicator block is in place and then loosen the 8 mm gland nut holding the indicator. Adjust the indicator placement on the frame until the Spindle Starting Position is within tolerance. Carefully tighten the gland nut and be sure the indicator is secure. It should not move or rotate, and the Spindle Starting Position should not change as the gland nut is tightened. Place a dab of proof lacquer at the gland nut and stem as a tamper-proof seal.

Contacting Electronics Inc.

Mailing and Shipping Address:

Electronics Inc.

56790 Magnetic Drive

Mishawaka, IN 46545 USA

Telephone: 1-800-832-5653 (Toll-free in USA and Canada) or (574) 256-5001

Fax: (574) 256-5222

Email: sales@electronics-inc.com

Website: www.electronics-inc.com

Limited Warranty

The warranty obligations of Electronics Inc. for the TSP-M are limited to the terms set forth below.

Length of Warranty Period

This limited warranty lasts one (1) year from the shipping date of this product from Electronics Inc. or its authorized distributor.

What is Covered

This limited warranty covers defects in materials and workmanship in this product.

What is Not Covered

This limited warranty does not cover any damage or deterioration of this product resulting from any alteration or modification, improper or unreasonable use or maintenance, or improper handling or storage.

How to Obtain a Remedy Under This Limited Warranty

To obtain a remedy under this limited warranty, contact Electronics Inc. or distributor from whom this product was purchased. If it is determined that this product must be returned under this limited warranty, a Returned Goods number (RG), obtained from Electronics Inc., will be required. This product should be properly packed, preferably in the original carton, for shipping. Cartons not bearing a RG number will require additional processing time. Shipping and insurance charges must be prepaid; Electronics Inc. is not responsible for these expenses.

What Electronics Inc. Will Do Under This Limited Warranty

Electronics Inc. will, at its sole discretion, provide one of the following two remedies to whatever extent it shall deem necessary to satisfy a proper claim under this limited warranty:

- 1) Repair the product. Electronics Inc. will pay the shipping costs necessary to return this product to the customer once the repair is complete.
- 2) Replace this product with a comparable current model. Electronics Inc. will pay the shipping costs necessary to replace this product.

Limitation on Liability

The maximum liability of Electronics Inc. under this limited warranty shall not exceed the actual purchase price paid for the product. Electronics Inc. is not responsible for direct, special, incidental or consequential damages resulting from any breach of warranty or condition, or under any other legal theory to the maximum extent permitted by law.

Exclusive Remedy

To the maximum extent permitted by law, this limited warranty and the remedies set forth above are exclusive and in lieu of all other warranties, remedies and conditions, whether oral or written, express or implied. To the maximum extent permitted by law, Electronics Inc. specifically disclaims any and all implied warranties, including, without limitation, warranties of merchantability and fitness for a particular purpose. If Electronics Inc. cannot lawfully disclaim or exclude implied warranties under applicable law, then all implied warranties covering this product, including warranties of merchantability and fitness for a particular purpose, shall apply to this product as provided under applicable law.

Rights under State Law

This warranty defines specific legal rights relative to these products provided by Electronics Inc. Legal rights may also vary from state to state.

Appendix

Introduction to Correlation

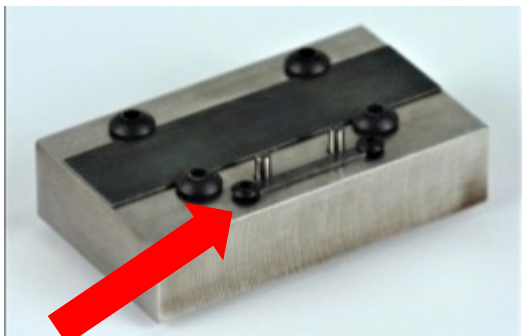
Almen mini-strips must be compared to standard-size Almen strips to assure compliance with intensity measurement practices. The comparisons are described in correlation trials where the standard Almen strip is used to set the requested intensity and the mini-strip is presented to the same blast stream. It is important to document the test results, especially the parameters and all test conditions. Testing multiple strips and the creation of a histogram can help validate the process.

The Almen Strips and Correlation Holder

It is convenient topeen the standard-size Almen strip and the mini-strip at the same time using a correlation holder. There are two methods of affixing the mini-strip to the correlation holder. In the first method, two screws secure the ends of the mini-strip. For the second method, double-sided adhesive tape or a temporary glue adhesive, such as rubber cement, secures the mini-strip to the holder. The second method is used only when it is not possible to attach the mini-strip to the holder with two screws.

For both methods, the standard Almen strip must be affixed to the holder with four screws.

The first image below shows the method using two hold-down screws to secure the mini-strip to the EI Correlation Holder for mini-strips (Electronics Inc. part number 970070). The strip is positioned next to two protruding back-stops to help keep it aligned. In the second image, the mini-strip is attached to the holder with double-sided tape.



Two screws holding a mini-strip in place



A mini-strip held in place with double-sided tape. This method should be used only when the mini-strip cannot be attached to the holder with screws.

It is very important to use only one method. The two hold-down screws will keep the strip firmly secured to the holder during the blast cycle while the tape or glue may allow some lift-off or curvature. This curvature may influence the mini strip response. As long as the technique is consistent, the results should be consistent. A sufficient number of trials should be run to validate the procedure. The examples shown in the next section titled “Examples of Correlation” use multiple trials and the data is shown in a statistical capability chart (histogram).

When in doubt, run more tests and analyze the data carefully.

Note: When using tape or glue to affix the mini-strip to the holder, make sure the tape and glue are completely removed from the holder and strip before measuring the strip or reusing the holder.

Examples of Correlation

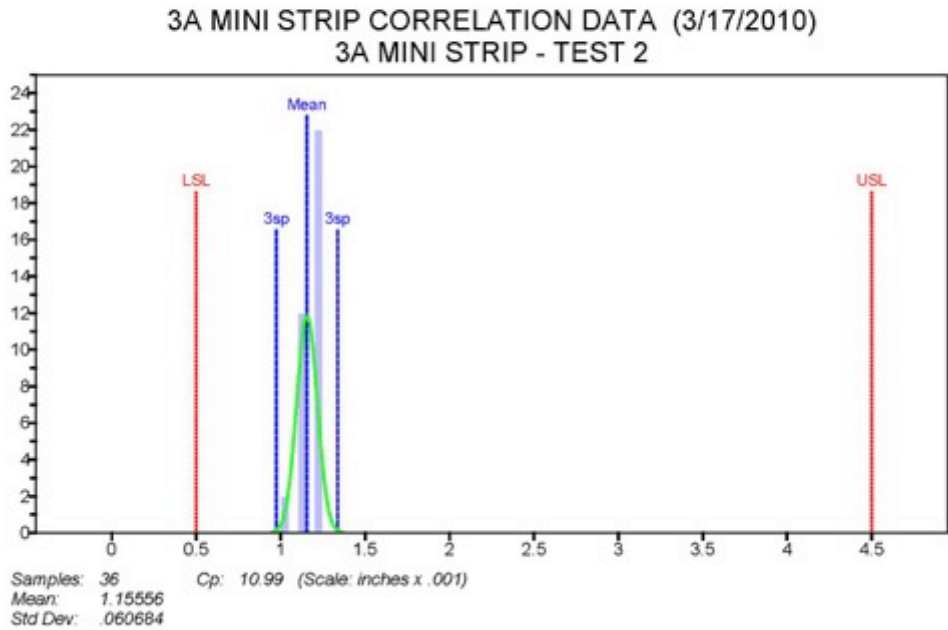
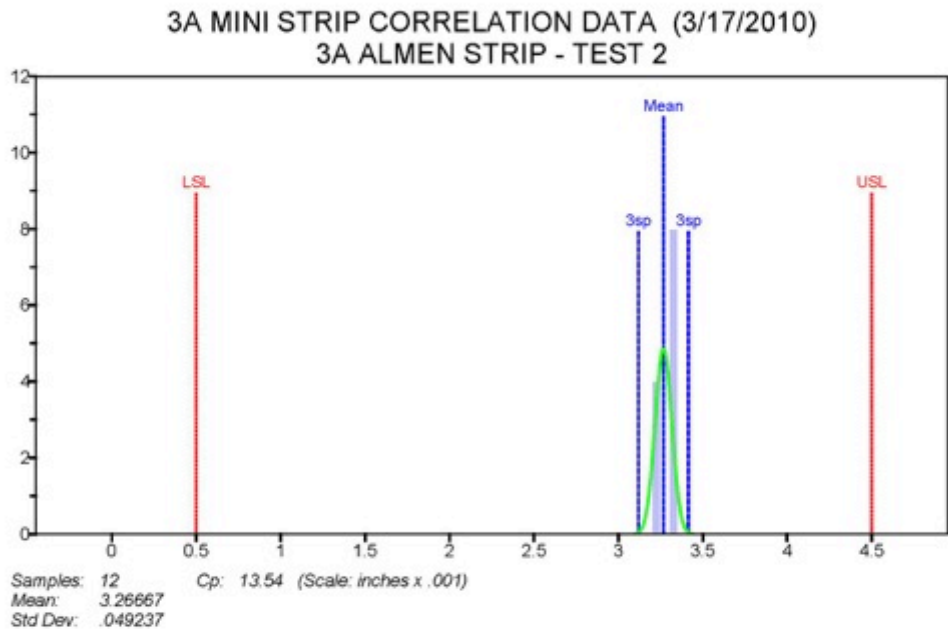
The following examples of correlation between standard-size Almen strips and mini-strips are for illustration only. Actual correlation must always be done on a job-specific basis. The special Almen holder for correlation uses two screws to capture the mini-strip. Other methods may be used such as double-sided tape or temporary adhesive (e.g., rubber cement). For best results, all procedures must be consistent. When in doubt, repeat a test.

	Test	Standard Strip x .001 inch	Mini Strip x .001 inch
Graph 1	3A to A mini (36) samples test 2	3.26 A	1.15 Mini A
Graph 2	3A to A mini (36) samples	3.25 A	1.25 Mini A
Graph 3	3A to A Mini 2 tests	3.5 A 3.26 A	1.25 Mini A 1.15 Mini A
Graph 4	6A to A Mini 2 tests	5.79 A 5.95 A	2.40 Mini A 2.46 Mini A
Graph 5	6A to A Mini Test 2	5.95 A	2.46 Mini A
Graph 6	6A to A Mini	6.09	2.40 Mini A
Graph 7	12A to A Mini and N Mini	12.08 A	5.68 Mini A 18.40 Mini N
Graph 8	12A to A Mini	12.32 A	4.93 Mini A
Graph 9	12A to A Mini	12.08 A	5.68 Mini A

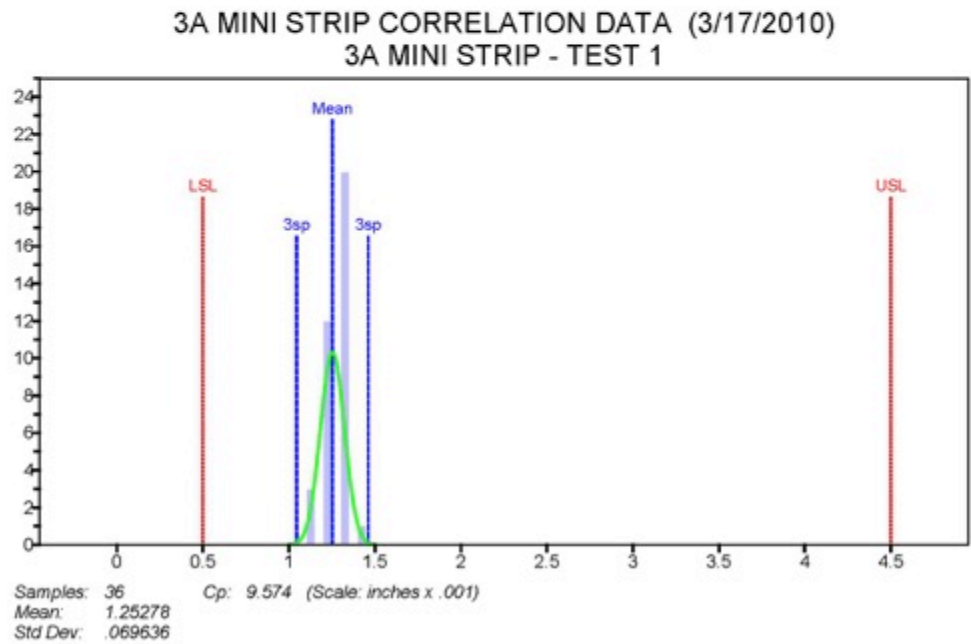
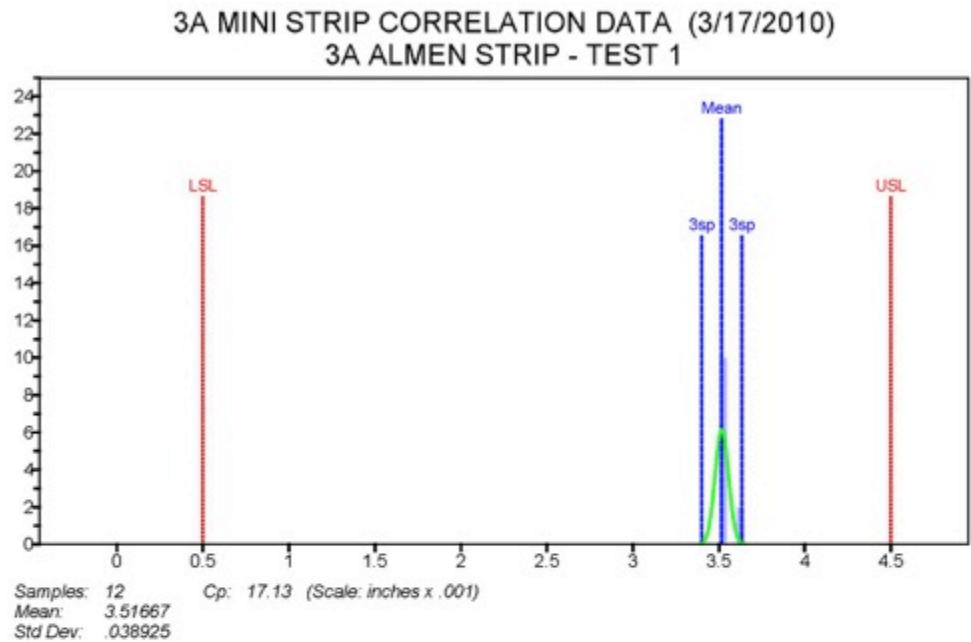
Note: These examples are for illustration only. Differences in machine design, nozzle type and placement, type and size of media, and media condition can affect results. Document what you do and do what you document. When in doubt, repeat a test. Keep accurate records of every test. Use a curve solver certified to SAE J2597. Place the mini-strip on the gage multiple times to assure the reading is consistent.

Do not rely upon these examples. We do not warrant that these examples will be appropriate for your applications. Create your own correlation studies.

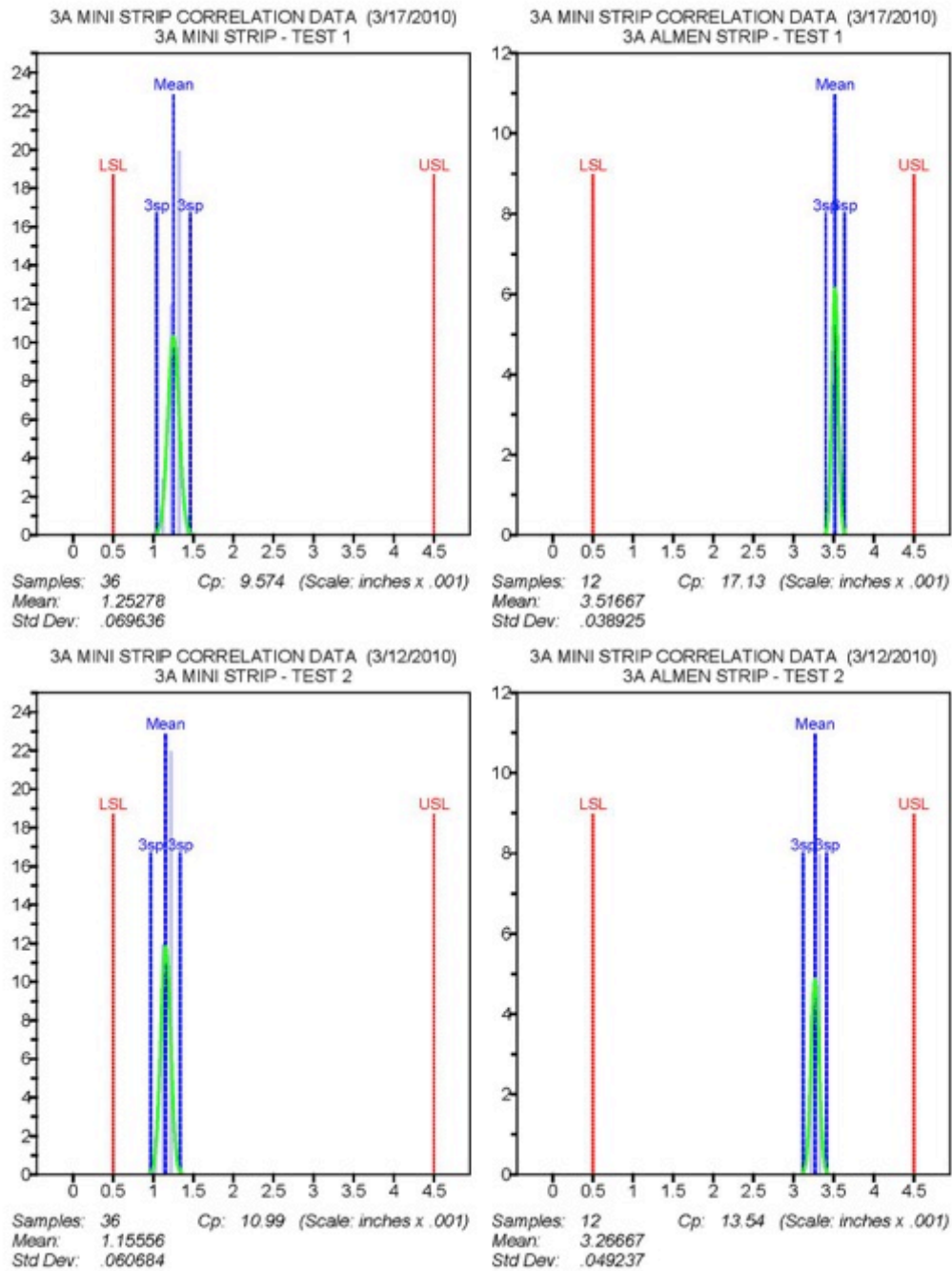
Graph 1 - 3.26 A to 1.15 Mini A



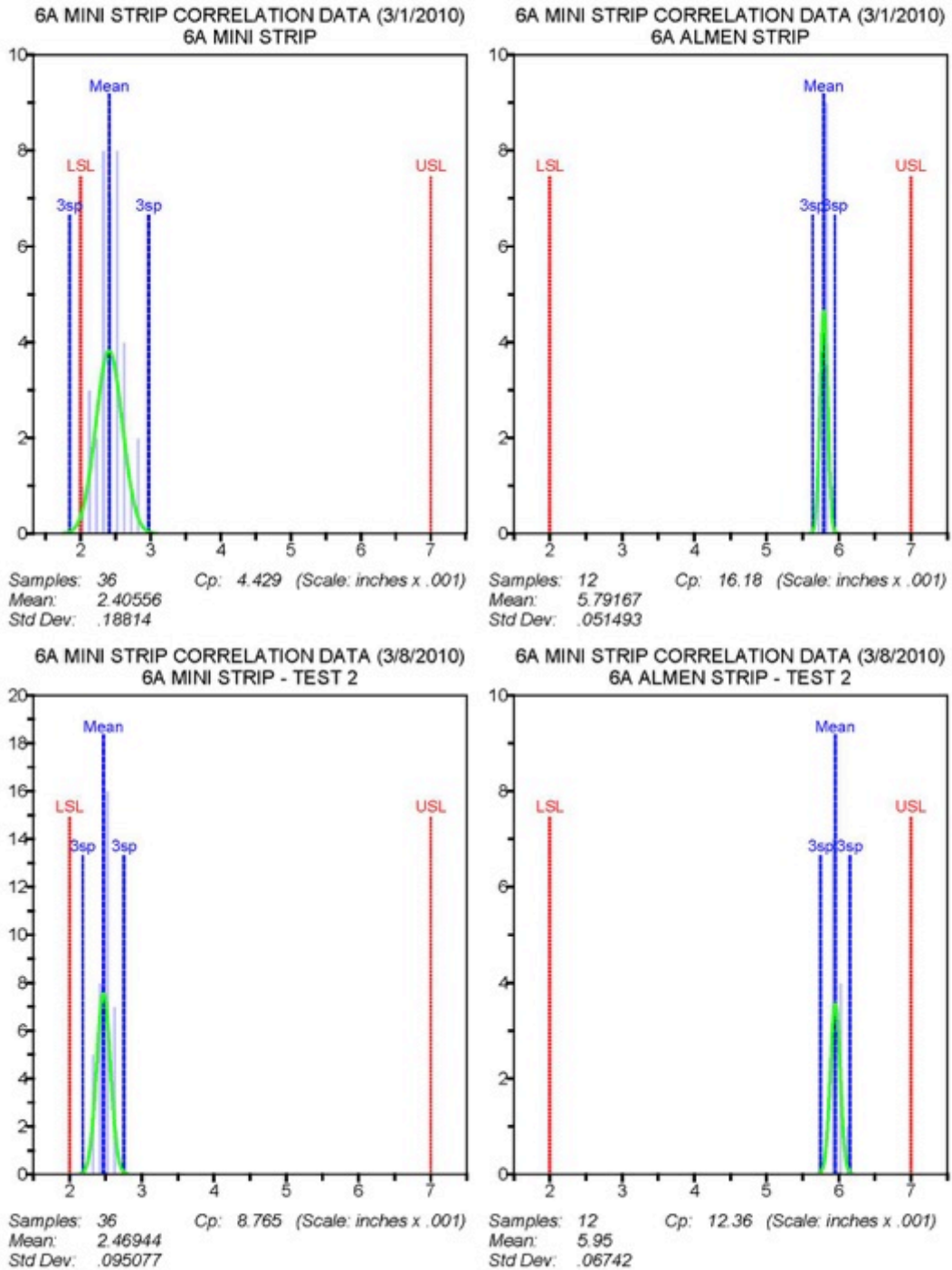
Graph 2 - 3.25 A to 1.25 Mini A



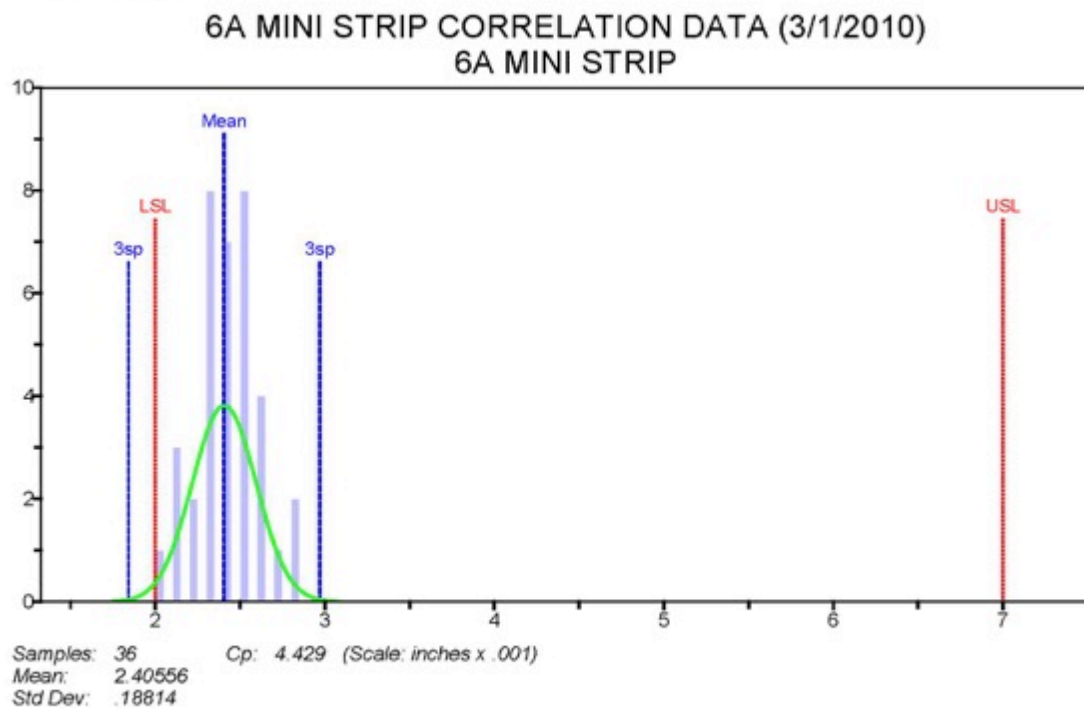
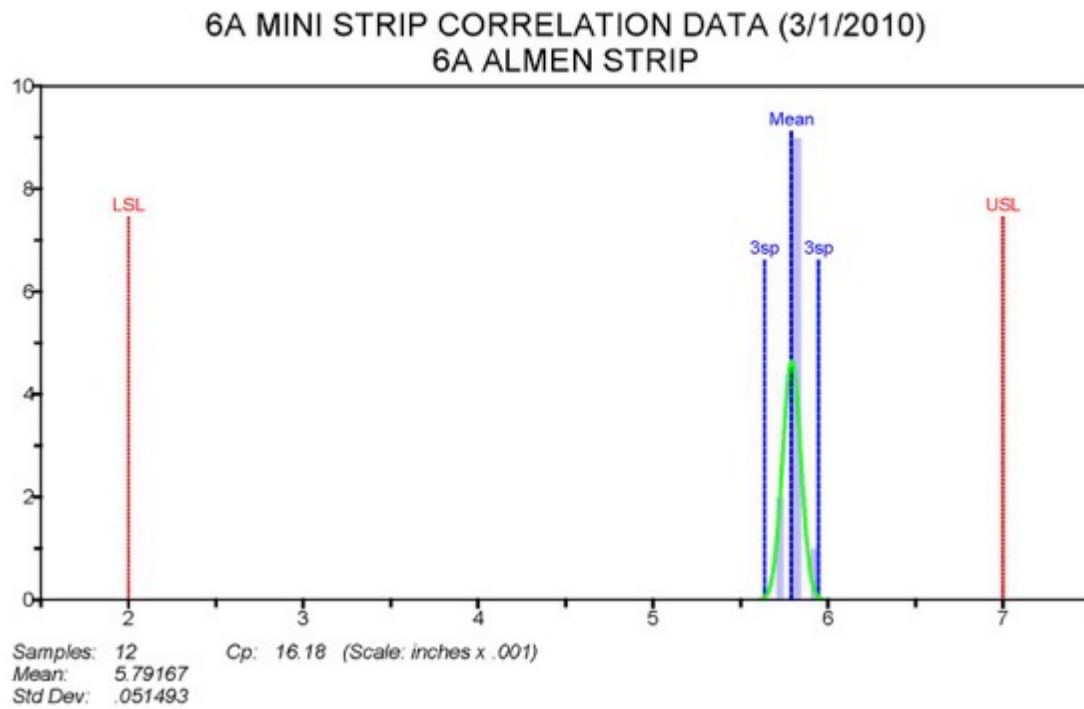
Graph 3 – 3.5 A to 1.25 Mini A, 3.26 A to 1.15 Mini A



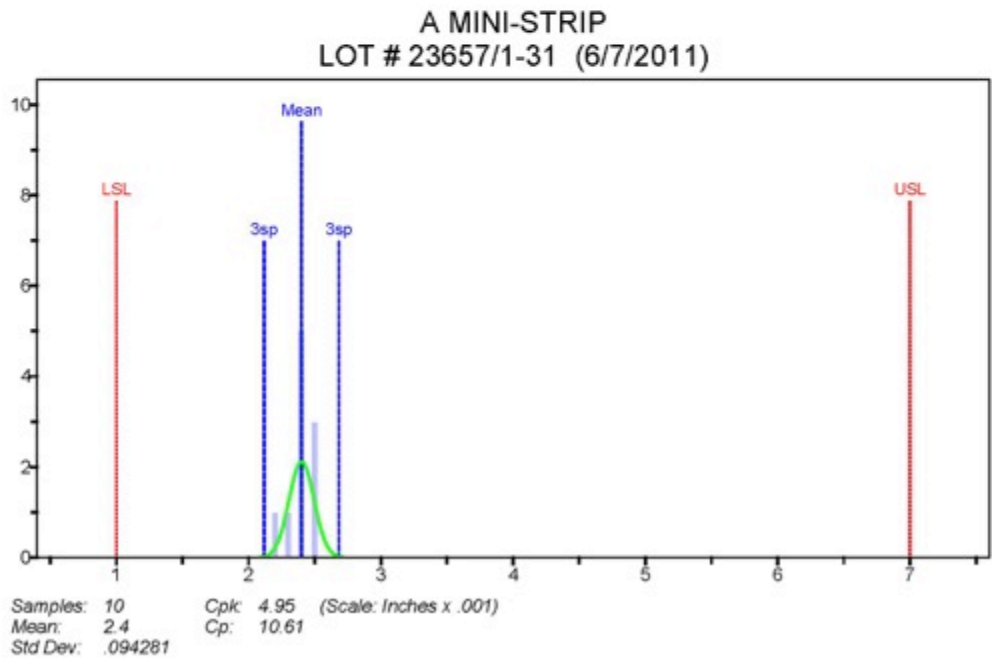
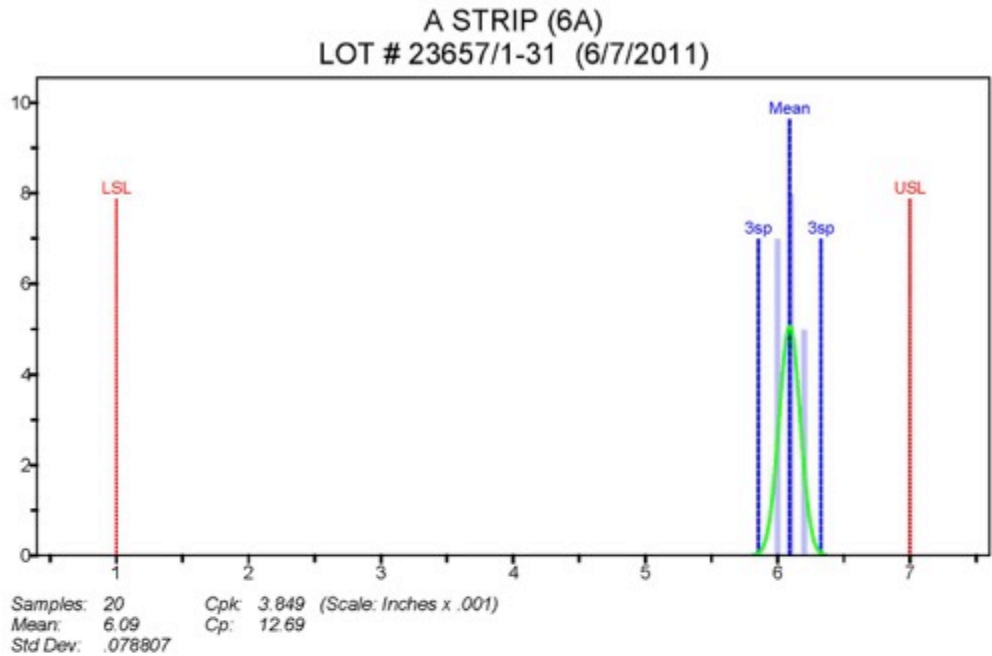
Graph 4 - 5.79 A to 2.40 Mini A, 5.95 A to 2.46 Mini A



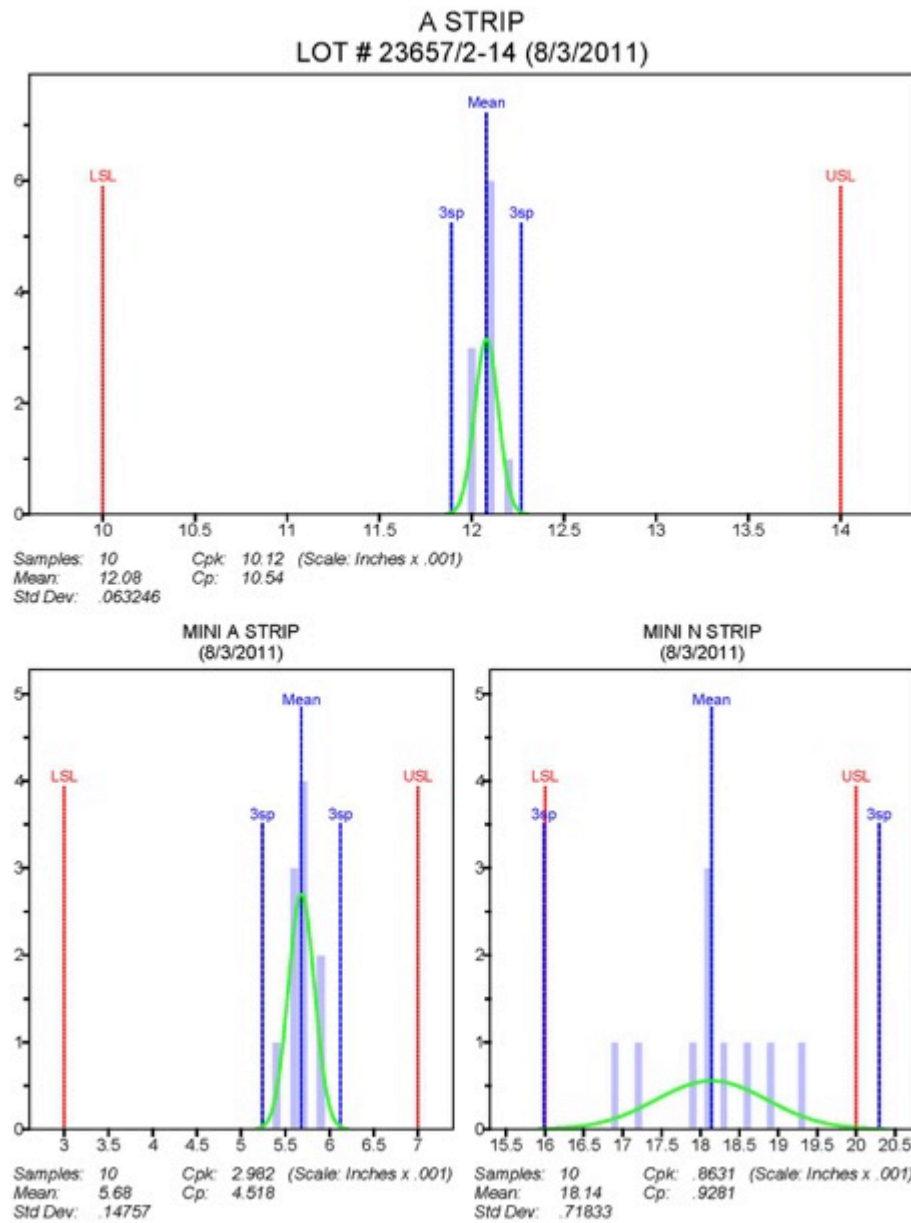
Graph 5 - 5.95 A to 2.46 Mini A



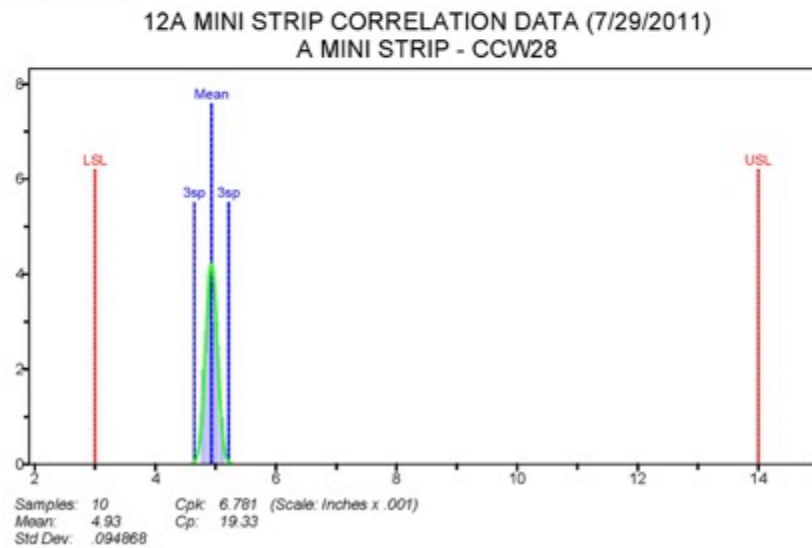
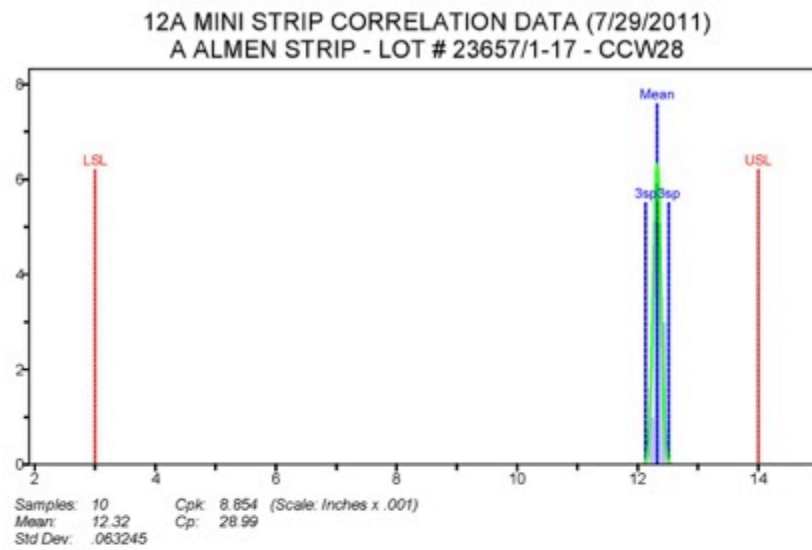
Graph 6 - 6.09 A to 2.40 Mini A



Graph 7 - 12.08 A to 5.68 Mini A, 18.40 Mini N

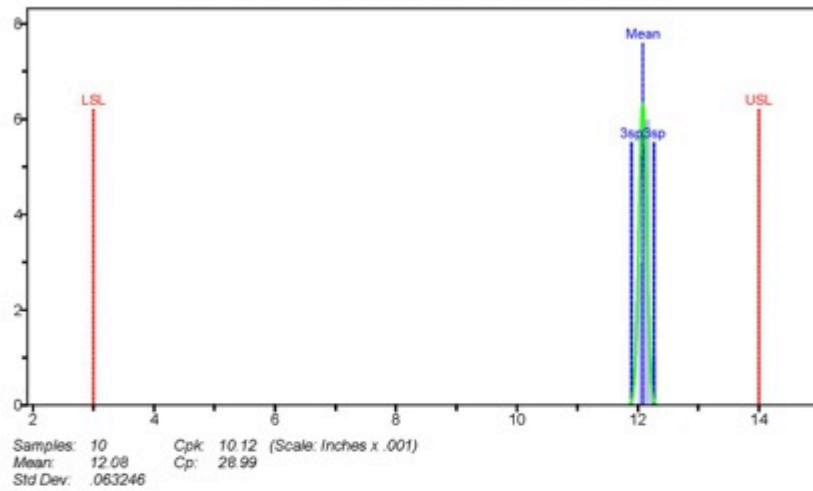


Graph 8 - 12.32 A to 4.93 Mini A

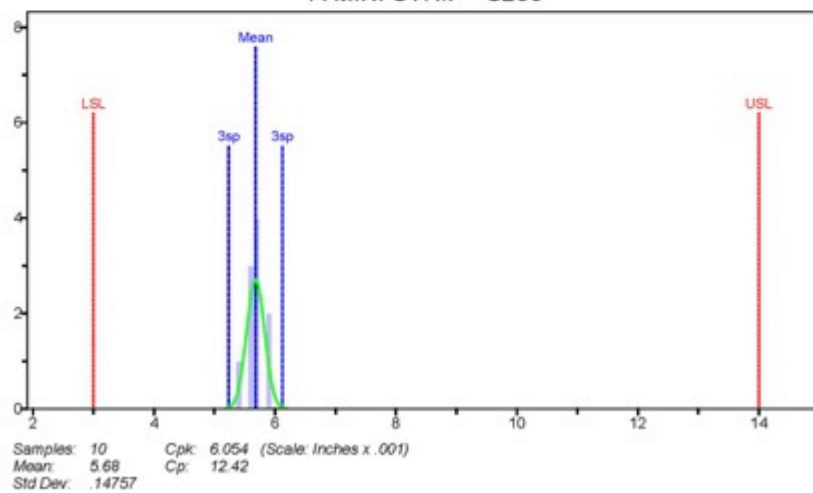


Graph 9 - 12.08 A to 5.68 Mini A

12A MINI STRIP CORRELATION DATA (8/3/2011)
A ALMEN STRIP - LOT # 23657/2-14 - S230



12 A MINI STRIP CORRELATION DATA (8/3/2011)
A MINI STRIP - S230



Compilation of Correlation Data

The following graph compares the performance of the standard “A” strip to the “A” mini-strip based on the previous graphs. The examples shown in this document are included for educational purposes only. Do not rely upon this data. We do not warrant that these examples will be appropriate for your applications. Create your own correlation studies.

