

2017 Almen Strip Consistency Testing Results

QUALITY CONTROL TESTING SINCE 2007

Electronics Inc. (EI) developed a performance consistency testing program on their A and N Almen strips in 2007 to ensure they are consistent in thickness, flatness and hardness. The purpose of EI's testing program is to verify that the strips will perform consistently, from lot to lot, from year to year.

TESTING METHOD

EI built an air blast cabinet with a variable speed rotary table with 26 Almen strip holders, a fixture for adjusting nozzle distance from the strips, a MagnaValve® for media flow rate control, and controls to adjust air pressure and table rotation. During testing, the table is rotated at a fixed speed, and the cabinet is set for a specific pressure and constant media flow rate so each strip passes under the blast nozzle at the same angular velocity for the same predetermined number of revolutions.

For each test, a sample size of 40 strips is used. EI measures and records the flatness of the strips before testing. After each test cycle, the arc heights are measured on a calibrated Almen gage and the flatness compensation is applied. The values are put into histograms for analysis. A histogram is a graphical display of tabulated frequencies, shown as bars. It shows what proportion of cases fall into each of several categories. A histogram differs from a bar chart in that it is the area of the bars that denotes the value, not the height of each bar.

TEST RESULTS

Histograms exhibit nearly identical lot-to-lot arc height results, thereby verifying the uniformity of the product. The 2016 and 2017 test results in a histogram format are on page 46 and test results from 2007 to 2017 are available at www.electronics-inc.com.

Each histogram represents a test to verify the performance of an individual lot. The results illustrate the performance consistency of the strips as defined by the nearly identical mean values and the narrow standard deviations. The mean is the sum of the observations divided by the number of observations. The mean describes the central location of the data, and the standard deviation describes the spread. The standard deviation is a statistic that tells how tightly all the examples are clustered around the mean in a set of data. When the examples are tightly grouped together and the bell-shaped curve is steep, the standard deviation is small. When the

examples are spread apart and the bell curve is relatively flat, it signifies a relatively large standard deviation. In the case of the Almen strip testing, the tight standard deviation signifies the consistency of the arc height reading.

In addition to documented consistency results, this testing program has provided a substantial technical support base for EI's Almen strip customers. EI has available:

- Current lot-to-lot comparison data on EI strips
- Comparisons of EI strips to other strips
- Performance data on other strips
- Analysis on the effect of variations in manufacturing parameters (hardness, thickness, etc.)

EI's research is thoroughly documented. For each test, EI records the scope, setup parameters, procedures, test results and analysis, histograms, saturation curves (where applicable), and a summary conclusion.

EI uses the performance data to answer customers' questions related to process variables and to help customers identify performance problems such as arc height variations and out-of-spec results with non-EI strips.

When EI does not have data available on a unique problem, EI will perform tests to analyze a customer's problem or even duplicate, as closely as possible, their process setup. ●



The EI custom test cabinet.

TRIVIA

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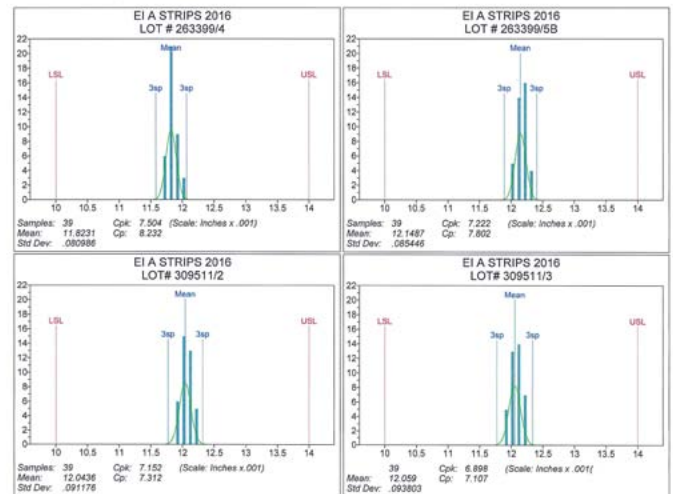
PERFORMANCE TESTING

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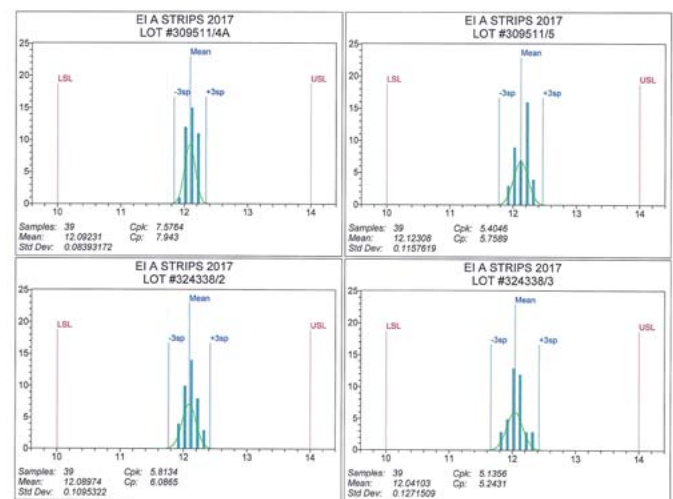
ANSWERS

- General Dynamics.** The F-16 was one of only two fighters capable of pulling 9+ g's.
- Lockheed.** Known in Canada as the Widow Maker and the Flying Coffin.
- McDonnell Douglas.** A mach 2.5 fighter, fastest in the U.S arsenal.
- Northrop.** The F-20 was modelled after the F-5.
- North American.** The Mustang was a World War II fighter aircraft and it also saw service in the Korean War.
- McDonnell Douglas.** The Phantom first entered service in 1960, having been developed and built by McDonnell Aircraft. When the company merged with Douglas, the joint company continued to manufacture the Phantom. Its last operational flight was in 1996.
- Grumman.** The Tomcat was the first swept-wing variable geometry wing type aircraft for the U.S Navy.
- Lockheed.** The Nighthawk stealth fighter first flew in 1981 although the USAF denied its existence until 1988. It was officially retired from service in 2008.
- General Dynamics.** The Aardvark entered service with the US Air Force in 1967 and was operational until 1998 when the EF-111 variant was retired. It was also used by the Royal Australian Air Force, whose planes were in use until 2010.
- Douglas.** The Douglas Aircraft Company designed and produced the Skyhawk before it merged with McDonnell in 1967 to form McDonnell Douglas.
- British Aerospace.** The Harrier was the most successful of the "vstol" (vertical short takeoff landing) aircraft. It was originally manufactured by Hawker-Siddeley and later developed by British Aerospace.
- Fairchild Republic.** This aircraft is equipped with a cannon used to take out tanks and is known as the tank killer. The bullets are made from depleted uranium.
- Ling-Temco-Vought.** The Corsair II entered service in 1967 with the last operational flight by a USAF plane taking place in 1991. It continued in service with the Portuguese Air Force until 1999.
- Grumman.** The Intruder was in service with the US Navy from 1963-1997.
- Sepecat.** The Sepecat Jaguar was a joint Anglo-French aircraft that served with the Royal Air Force from 1973 to 2007.
- Saab.** The Saab 37 Viggen served with the Swedish Air Force from 1971-2005. It is not to be confused with the Saab 93 Viggen which was a car.
- Canadair.** The Tutor was flown by the Canadian Armed Forces acrobatic team—the Snowbirds.
- Vought.** The F4U Corsair was a World War II aircraft that first flew in 1942 and it also saw active service in the Korean War.
- Dassault-Breguet.** The Mirage 2000 was a mach-2 delta winged aircraft.
- Northrop.** The Tiger II was used by the U.S Air Force in their top gun training to simulate the Mig-21.

2016



2017



Each histogram represents a 40-piece sample size with the x-axis as the arc height of the strip after peening and the y-axis indicating the number of samples measured at that value (arc height values x .001 inches).

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