



ELECTRIC STITCH VS. CONTINUOUS PATTERNS: ADHESIVE USAGE COMPARISON

Objective

The purpose of this test is to quantify the reduction in adhesive usage achieved by using a high-speed electrically operated gun dispensing a stitch pattern, as opposed to a pneumatically operated gun dispensing a continuous pattern. In order to provide a valid comparison, both guns will be set up to dispense patterns of equivalent length and width.

Overview

First, a baseline must be established to quantify the performance of the existing pneumatic guns. The first step is to seal a number of cases and set them aside for later reference. The length and width of the compressed beads from these cases will be compared to those of cases sealed using a stitch pattern produced by the electric guns.

The next step is to accurately measure the adhesive dispensed by the existing pneumatic system. This is achieved by manually triggering the photo-eye that activates the guns and collecting the dispensed adhesive in aluminum trays. These trays are then weighed on a digital scale, and the corresponding adhesive output is recorded. In order to ensure an accurate measurement, the guns are fired 10 times into each tray, and 5 trays are collected from each gun. The samples from each gun are then added, averaged and divided by 10 to obtain the average adhesive usage per case.

At this point, the pneumatic guns are removed and replaced with electric guns. Next the stitch pattern is dialed in and a number of cases are run for comparison against the cases that were sealed earlier with the pneumatic guns.

Finally, the adhesive dispensed by each electric gun is measured in the same way as before, firing the guns 10 times into each tray and collecting 5 trays from each gun. The samples from each gun are then used to calculate the average adhesive usage per case.

Results

Table 1 shows the amount of adhesive dispensed by the pneumatic guns applying a continuous pattern. This is broken down into measurements for the front gun, the back gun and the total for both guns. As described earlier, these measurements represent the total adhesive dispensed on 10 cases. The total amount of adhesive used on each case is found to be 1.19 grams.

Table 2 shows the amount of adhesive dispensed by the electric guns applying a stitch pattern. As shown above, the total amount of adhesive used on each case falls to 0.43 grams, representing a reduction in adhesive usage of 64%.

| Adhesive usage (grams)* | | | |
|-------------------------|-------------|--------------|----------|
| Sample | Back gun ** | Front gun ** | Total ** |
| 1 | 6.09 | 5.77 | 11.86 |
| 2 | 6.13 | 5.68 | 11.81 |
| 3 | 6.39 | 5.94 | 12.33 |
| 4 | 6.29 | 5.83 | 12.12 |
| 5 | 6.02 | 5.35 | 11.37 |

* Pneumatic guns dispensing a continuous pattern.

** Each sample represents usage for 10 cases.

Average Usage for 10 Cases (grams): 11.90

Average Usage per Case (grams): 1.19

Table 1. Adhesive Usage – Pneumatic Guns

| Adhesive usage (grams)* | | | |
|-------------------------|-------------|--------------|----------|
| Sample | Back gun ** | Front gun ** | Total ** |
| 1 | 2.09 | 2.10 | 4.19 |
| 2 | 2.10 | 2.22 | 4.32 |
| 3 | 2.09 | 2.19 | 4.28 |
| 4 | 2.16 | 2.18 | 4.24 |
| 5 | 2.07 | 2.22 | 4.29 |

* Electric guns dispensing a continuous pattern.

** Each sample represents usage for 10 cases.

Average Usage for 10 Cases (grams): 4.26

Usage per Case (grams): 0.43

Percent reduction in adhesive usage: 64%

Table 2. Adhesive Usage – Electric Guns

Lastly, the dimensions of the beads produced by the pneumatic and electric guns are compared to verify that the overall lengths and widths of the beads are equivalent. These measurements were taken by opening the flaps on a sealed case and measuring the compressed adhesive beads. The following table shows the dimensions of the beads produced by the pneumatic guns.

| Pattern Dimensions (inches) | | | |
|-----------------------------|--------|------------|-------------|
| Pattern | Length | Avg. Width | Avg. Height |
| 1 | 1.47 | 0.25 | 0.025 |
| 2 | 1.4 | 0.22 | 0.025 |
| 3 | 1.65 | 0.3 | 0.025 |
| 4 | 1.61 | 0.35 | 0.025 |

* Pneumatic guns dispensing a continuous pattern.

Table 3. Pattern Dimensions – Pneumatic Guns

The following table shows the dimensions of the beads produced by the electric guns. Each stitch pattern consists of 3 beads. The dimensions of each bead, as well as the overall length of the stitch pattern, are shown in the table below.

| Pattern Dimensions (inches) | | | | | | | | |
|-----------------------------|--------|--------|--------|-------|------------|--------|--------|-------------|
| Pattern | Length | | | | Avg. Width | | | Avg. Height |
| | Bead 1 | Bead 2 | Bead 3 | O'all | Bead 1 | Bead 2 | Bead 3 | |
| 1 | 0.41 | 0.40 | 0.39 | 1.42 | 0.26 | 0.26 | 0.22 | 0.009 |
| 2 | 0.45 | 0.40 | 0.38 | 1.48 | 0.23 | 0.25 | 0.30 | 0.009 |
| 3 | 0.40 | 0.40 | 0.40 | 1.43 | 0.22 | 0.26 | 0.23 | 0.009 |
| 4 | 0.41 | 0.40 | 0.40 | 1.48 | 0.26 | 0.26 | 0.30 | 0.009 |

* Electric guns dispensing a stitch pattern.

Table 4. Pattern Dimensions – Electric Guns

It can be seen that the average widths of the beads produced by the electric guns were equivalent to those produced by the pneumatic guns, despite having a smaller average height and volume. Since bond strength is a function of the area of the compressed bead, a larger bead height wastes adhesive without increasing strength. Given that the dimensions of the beads produced by both systems are equivalent, one would expect that cases sealed with the electric guns would have similar strength as those sealed with the pneumatic guns.

Summary

A reduction in adhesive usage of 64% was achieved by using a high-speed electrically operated gun dispensing a stitch pattern, as opposed to a pneumatically operated gun dispensing a continuous pattern. Furthermore, comparison of the sealed cases verified that the stitch pattern produced by the electric guns compresses to a similar area as the continuous pattern produced by the pneumatic guns, indicating that the strength of the bond should be equivalent.

| Test Parameters | | |
|-------------------|---------------------|--------------------|
| | Pneumatic Gun Tests | Electric Gun Tests |
| Melt Unit | NC-20 | NC-20 |
| Gun | NCH 20 4 RW | KJC0912 |
| Nozzle | 971XX106 | 971XX107 |
| Pump Air Pressure | 35 psi | 25 psi |
| Stitch Pattern | - | 5 ms |
| Stitch Gap | - | 5 ms |
| Pattern Length | - | 25 ms |

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