Effects of Switch Break-in Machine on Mechanical Switches

Performed:
June 14, 2021

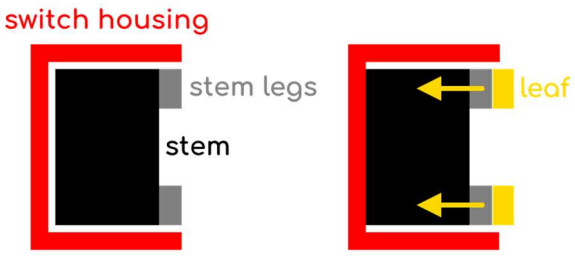
Introduction:

The term "break-in" is defined as: "An initial period of operation during which working parts begin to function efficiently", or, "To overcome the stiffness or newness of" (merriam-webster.com).

In terms of mechanical switches, the process of "break-in" is used on brand-new switches in order to increase the perceived smoothness upon use. This is done by actuating the switch to simulate use. The effect of the process is debatable, some state all switches need break-in while others state it is only beneficial to some switches. Some also believe a break-in process following the lubrication of a switch will make the lubricant spread out more evenly.

Scratchiness and roughness in a switch is mostly caused by the moving parts rubbing against one another as a switch is being used. More specifically, the metal contact leaf pushes the stem in the direction of the led slot, causing a significant increase in friction and scratchiness. This can be proven by removing the contact leaf on a switch, which will provide a much smoother experience.

If there are no differences between broken-in and stock switches, the success rate when differentiating between them should be 50%. If the experimental result is significantly greater than 50%, that means the difference is significant between the 2 groups of switches.



Purpose:

To determine if the automatic break-in process made possible by the Feng Studio Break-in Machine have positive effects on mechanical switches when it comes to improving smoothness.

Hypothesis:

The automatic break-in process will improve smoothness on the switches being tested. More specifically, a success rate of >85% will be observed when it comes to differentiating between stock and broken in switches.

Materials:

- Kiwi switches (broken-in & stock, 30 of each)
- Masking tape
- 2 identical containers
- Marker

Procedures:

1. Separate the switches into groups of 3
2. Label the containers as #1 and #2.
3. A partner will put 1 group of the switches into container #1, record whether it contains stock or broken-in switches on table 1 by highlighting the correct type.
4. Repeat step 3 with another group of switches and container #2, this can also be broken-in or stock.
5. A partner will rearrange the 2 containers and give the samples to the test subject.
6. The test subject will feel the 6 switches, the partner will highlight "yes" if the two groups feel different, and "no" if the two groups feel the same.
7. After an answer is obtained, remove the switches and repeat steps 3-6 with 9 more sets of new switches.
8. After completing the steps above, scramble the switches and repeat steps 1-7 using the same switches in different combinations.

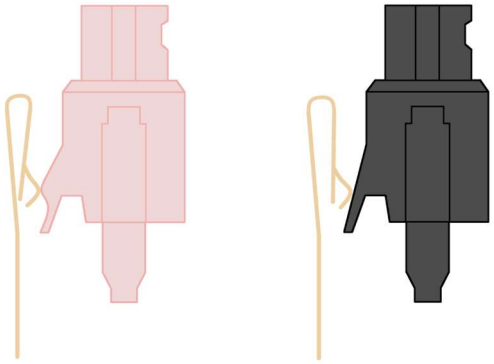
Observations:

Table 1: Switch Types vs Difference in Feel

Trial #	Container 1	Container 2	Difference	Correct?
1	Stock/broken-in	Stock/broken-in	Yes/no	✓
2	Stock/broken-in	Stock/broken-in	Yes/no	✓
3	Stock/broken-in	Stock/broken-in	Yes/no	✓
4	Stock/broken-in	Stock/broken-in	Yes/no	✓
5	Stock/broken-in	Stock/broken-in	Yes/no	✓
6	Stock/broken-in	Stock/broken-in	Yes/no	✓
7	Stock/broken-in	Stock/broken-in	Yes/no	
8	Stock/broken-in	Stock/broken-in	Yes/no	✓
9	Stock/broken-in	Stock/broken-in	Yes/no	✓
10	Stock/broken-in	Stock/broken-in	Yes/no	✓
11	Stock/broken-in	Stock/broken-in	Yes/no	✓
12	Stock/broken-in	Stock/broken-in	Yes/no	✓
13	Stock/broken-in	Stock/broken-in	Yes/no	✓
14	Stock/broken-in	Stock/broken-in	Yes/no	✓
15	Stock/broken-in	Stock/broken-in	Yes/no	✓
16	Stock/broken-in	Stock/broken-in	Yes/no	✓
17	Stock/broken-in	Stock/broken-in	Yes/no	✓
18	Stock/broken-in	Stock/broken-in	Yes/no	✓
19	Stock/broken-in	Stock/broken-in	Yes/no	✓
20	Stock/broken-in	Stock/broken-in	Yes/no	✓

Other observations:

Scratchiness is observed primarily throughout the tactile bump. It is suspected that this is due to the legs pushing further into the leaf during the tactile event. Which in turn causes the leaf to flex back towards the stem as reaction force. This reaction force is significantly stronger than one of a linear stem, as a tactile stem compresses the leaf more.



Tactile stem compresses the leaf more than a linear stem. (not to scale)

Analysis:

Success rate = successful trials/total trials = 19/20 = 95%

Conclusion:

The hypothesis is accepted, the automatic break-in process improves smoothness on the switches being tested. The success rate (95%) is greater than the predicted rate of 85%, and is significantly greater than 50%.