J34 Force Plate and High-Speed Video Analysis of the Stamping Device Application

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Learning Overview: The goal of this presentation is to show the forensic science community and, in particular, forensic document examiners the utility of applied force plates and high-speed video analysis of the biomechanical action of the application of stamping devices to paper.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by increasing awareness of the potential correlation between the kinetics of stamping and the resultant stamp impression.

Stamping devices are used extensively in business, government, and personal affairs. They may be used for a variety of applications such as: addresses, business procedures, official uses, packaging, decorative applications, and others. The examination of stamps and stamp impressions are part of the work of forensic document examiners. While there have been several references that address how stamp impressions may appear from the physical act of stamping, there has not been published research into the applied forces and appearance of the stamp impressions.

The act of applying stamping devices does result in variation in the appearance of the impressions. The range of variation in stamp impressions tends to be greater than that from other mechanical or electromechanical means such as that seen from office printers. Among a number of factors, the variation is due in part to the biomechanics of manually applying the stamping device to make an impression.[1]

In this study, several stamping devices were used to make impressions onto a variety of substrates, including office papers, receipts, envelopes, and cardstock. A pair of stamping devices with the same stamp dies was made; one was a self-inking stamp type, the other a traditional rubber stamp requiring a separate stamp ink pad. Other common stock stamps of varying sizes that are produced in large quantities were also tested. The stock stamps were of the self-inking and traditional stamp types.

Impressions from the different stamping devices were made with the various substrates on top of Advanced Mechanical Technology Inc. (AMTI®) portable force plates with data collection done by NetForce software. Force data in the *x,y,z* planes (F_x, F_y, F_z) were collected as well as rotational moment data about the *x,y,z* axes (M_x M_y, M_z) and stamp Center of Pressure (CoP) variability. During the stamping process, high-speed video was recorded using an MS 130K high-speed camera.

Examination of the stamp impressions and the data set from the force plates with high-speed video images was conducted to determine: (1) the typical range of forces applied during the stamping process; (2) whether artifacts in the stamp impressions could be correlated to the applied forces, (for example, if impressions are intentionally made with more force to one side of the stamp); (3) the range of applied force needed to make an idealized impression from a given stamp; and (4) the appearance of impressions at the extremes of minimum and maximum applied forces.

The examination of the impressions was conducted by both qualitative and quantitative means. Qualitative examinations were performed at a macroscopic and microscopic level for the impression appearance, including the presence of stamping artifacts. Quantitative analysis was accomplished by image analysis via the software ImageJ.

Reference(s):

1. Jan Seaman Kelly. Forensic examination of rubber stamps: A practical guide. Charles C Thomas Publishers, 2002.

Stamping Devices, Force Plate, Forensic Stamp Impressions