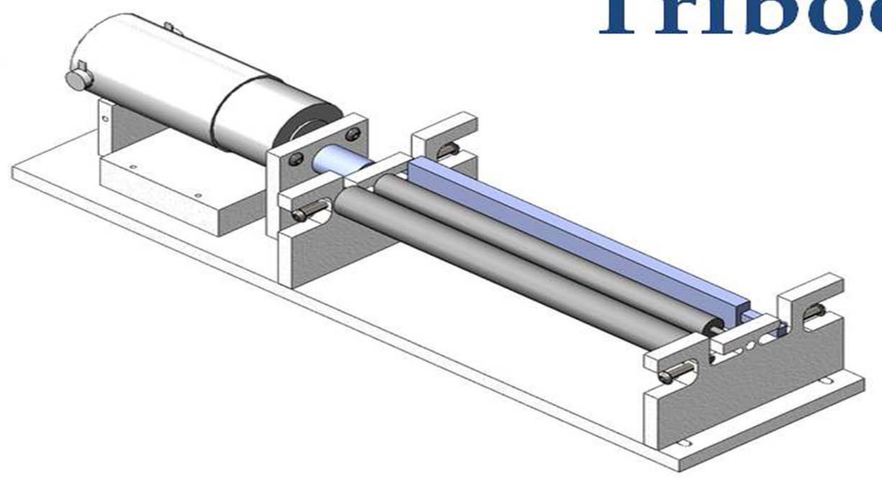
LEXMARK™

SCOPE

2009 - 2010

Triboelectric Charge Measurement

For the 2009-2010 school year, the Lexmark-SCOPE team was tasked with creating test equipment to measure the triboelectric charging and frictional properties of the rollers within Lexmark's printer cartridges.

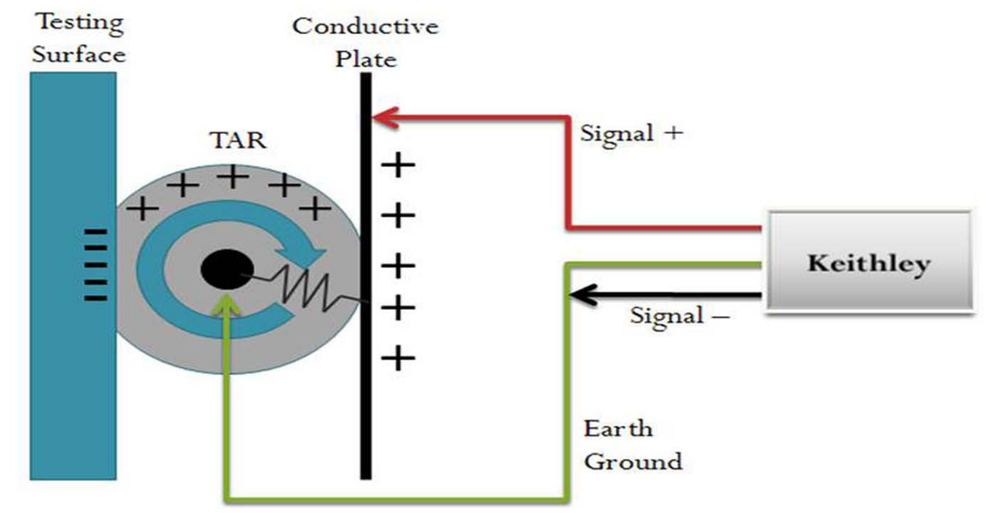


The Lexmark-SCOPE team created a measurement device to characterize the triboelectric charge properties of a rotating TAR with respect to various testing surfaces. The design allows for varying TAR sizes, TAR rotational speed, TAR foam compression, and triboelectric charging material, including various plastics and DRs. This triboelectric charge measurement device will allow Lexmark to make more energy efficient printers that depend more on this inherent phenomenon instead of on the electrical bias from the rollers.

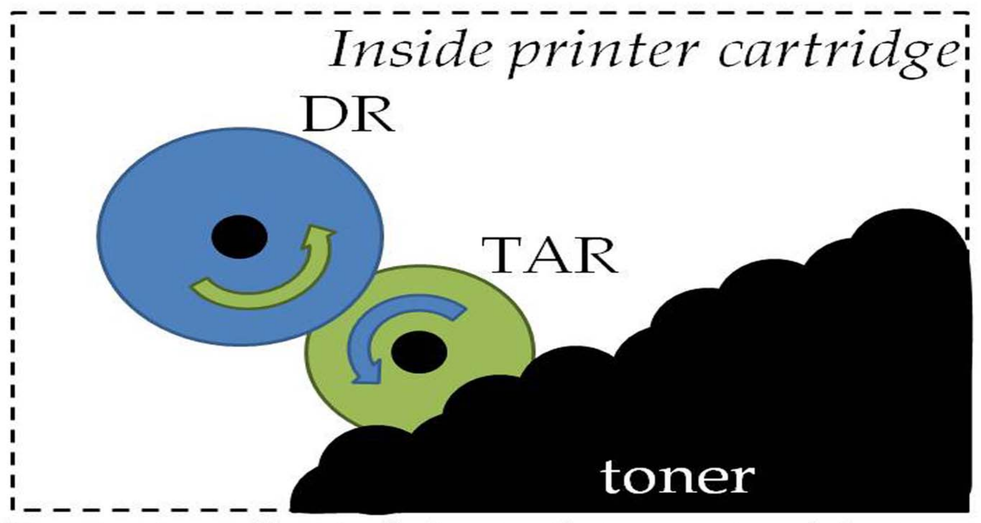
The Triboelectric Effect

The triboelectric effect describes how insulators can become charged through friction. It results from imbalanced electrochemical potentials attempting to balance when two insulators come into contact. Charge carriers first transfer from one material to the other. When the materials separate, the charge remains in the new material, which results in an overall charge.

The TAR spins against a material surface, becoming triboelectrically charged through contact adhesion (shown at right). As the roller continues to spin, the accumulated surface charges transfer to an opposing conductive surface. The produced current is measured by a Keithley® Electrometer and directly correlates to the triboelectric charge being produced. By measuring the current, Lexmark can study the effects of TARs' material properties on their triboelectric charging ability in order to improve overall printer function.

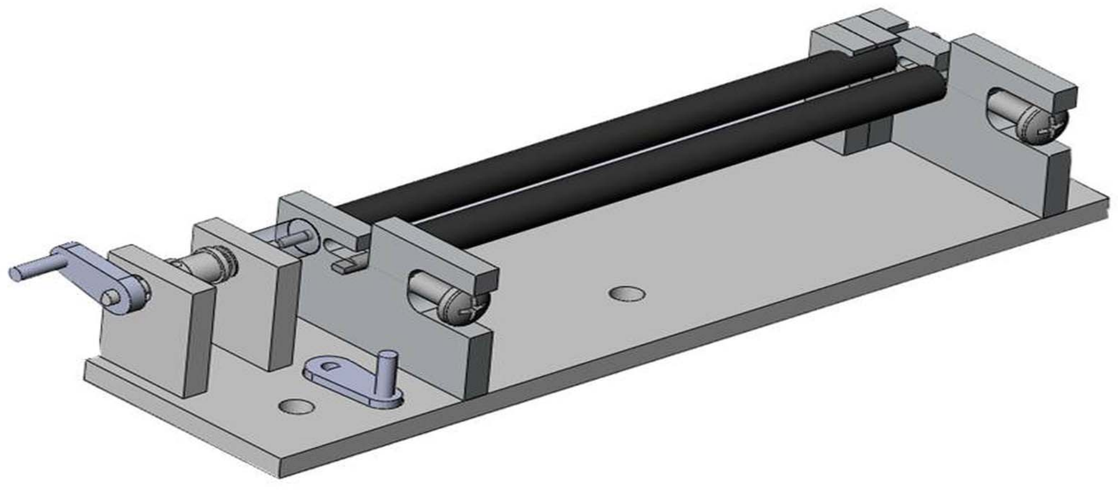


Inside a Printer Cartridge



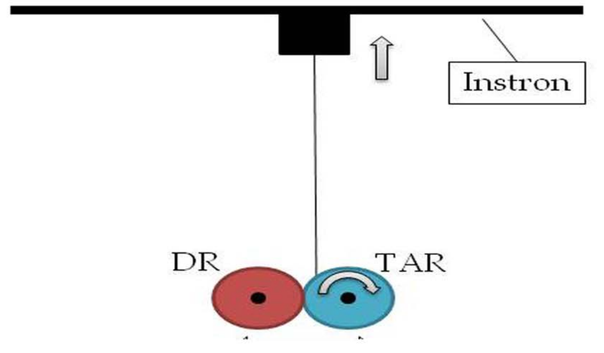
Toner is collected from the toner adder roller (TAR) and transferred to the developer roller (DR) through frictional triboelectric charging and electrical biasing from the rollers. The remaining steps in the laser-printing process depend on the charge obtained by the toner in this initial phase.

Friction Measurement



The interaction of and friction between the TAR and DR directly determines the amount of power required to spin the rollers, and thus the power consumed by the printer, as well as the life of the two rollers. Excessive friction will negatively impact the life of the rollers and other printer components. A better understanding of the rollers and their frictional properties will enable their optimization and the development of more efficient and longer lasting printers and print cartridges.

The friction testing device, pictured above, attaches to the base plate of an Instron ® Universal Tester. A spindle system is set-up such that when the Instron ® crosshead moves up, a shaft coupler rotates the TAR against a DR. The force measured by the Instron ® is directly proportional to the friction between the DR and TAR. By varying the compression of various DRs against TARs, Lexmark can study the effects of compression and material on friction within the printer cartridge.



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