

# Rotogravure Printed UHF RFID Antennae Directly on Packaging Materials

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## Abstract

In this work, rotogravure printing was employed to print conductive antenna patterns for radio-frequency identification (RFID) tags. A total of eight paper-based packaging substrates and one PET film were printed. A gravure cylinder was engraved at different resolutions, in order to evaluate the effect of engraving parameters on antenna performance and print attributes. Two silver-flake inks, water-based and solvent-based, were printed. The gravure print trials were conducted on a narrow-web flexographic press, modified to achieve transfer of the ink from an engraved image carrier directly onto the substrate, as in traditional rotogravure press set-up. Various test features were included in the printed image, such as RFID antennae designs for antenna performance measurement, and different lines for print quality and resistance measurements.

Multiple measurement methods were used to characterize the properties of printed samples. The resistance of the lines was obtained using low frequency AC measurement equipment. The dimensions (length and width) of the lines were measured using an image analysis system. The resistance and dimension results were combined to calculate sheet resistivity of the lines printed on each substrate. Further tests were performed to measure the radio frequency (RF) performance of the printed antennae.

Solvent-based and water-based ink systems showed differences in terms of pattern printability. From the three tested engraving resolutions, only two were found to be appropriate for obtaining acceptable antenna characteristics for both ink systems. Sheet resistivity and printed antenna performance results showed a dependence on the quality of the printed ink layers. A connection between antenna performance and AC resistance was investigated and a relationship established.

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