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## Classification and Identification of Photocopiers: A Progress Report

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The use and availability of photocopying equipment have increased tremendously in recent years. Rapid copying, easy access, simplicity of operation, and relatively low cost per copy are qualities that have made photocopying convenient not only for legitimate use but also for illegal activities.

Examiners of questioned documents are encountering, with increasing frequency, questioned documents which are photocopies rather than original documents. Although in many instances the photocopy is merely a substitute for an original document which is not available for examination, the production source of the photocopy is frequently a major point at issue. It has become apparent that the perpetrators of various crimes, aware of the possibility of their identification through the examinations of handwriting, typewriting, ink, or paper, have resorted to the use of photocopies in an attempt to eliminate or obscure the identifiable features of the original documents. Thus, the photocopies are often the only physical evidence available. Accordingly, a determination of the manufacturer and model of the machine which produced the photocopies becomes a primary concern. The subsequent location and identification of a particular machine could assist materially by limiting the search for possible suspects to those having access to the machine.


Obviously, to gather known samples indiscriminately from various sources in the hope of finding the right machine is time-consuming and has only a negligible chance of success. The odds improve considerably, however, if the manufacturer and model of photocopier used to produce the questioned copy can be determined. The gathering of known samples can then be limited to a particular model of photocopier.

In addition to the problem of copier classification, related questions concern the enlargement or reduction capability of the various machines, the possibility of determining the generation of the copy in question from the original document and the mechanical source and relative significance of the "trash" marks on copies which assist in identifying a particular machine. In late 1972 the decision was made to contact the manufacturers of photocopier equipment, obtain samples from their machines for further study, and gather technical information concerning the paper, toners, and other material used and the functions and capabilities of the machines. Sample test cards were designed for this purpose (Fig. 1).

A preliminary list of manufacturers was obtained by consulting the 12 March 1973

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**OFFICE COPIER STANDARDS FILE**

MANUFACTURED BY: \_\_\_\_\_  
 \_\_\_\_\_  
 MODEL \_\_\_\_\_  
 TYPE \_\_\_\_\_  
(electrostatic, thermal, etc.)

PAPER TYPE \_\_\_\_\_  
(plain, coated, roll, sheet, etc.)

PAPER SIZE (maximum) \_\_\_\_\_  
 COPY SIZE (maximum) \_\_\_\_\_  
 % OF REDUCTION OR ENLARGEMENT OF ORIGINAL DOCUMENT \_\_\_\_\_  
 TYPE FEED \_\_\_\_\_  
(rotary, flatbed, etc.)

  
 RESOLUTION SCALE

  
 GREY SCALE


  
 COLOR SCALE

FIG. 1—Sample test card.

edition of *Office Products News*, which contained the insert “Guide to Office Copiers and Toners.” This insert listed approximately 40 manufacturers of office copier equipment and their approximately 170 different models. In contacting these manufacturers it was discovered that some companies on the list no longer existed or were actually involved not in the manufacture of office copiers but rather in the distribution of them. To date, sample copies have been obtained from 106 models manufactured by 31 companies.

In addition to receiving copies directly from the manufacturers, sample copies were also obtained from copiers in actual use throughout the country. These samples were obtained to ensure that the significance of differentiating characteristics noted on the copies received from the manufacturer could be verified by comparison with copies from the same model copier which were acquired from other sources. A list of manufacturers and models is given in Table 1.

Examination of the various samples has been limited thus far to the search for observable physical markings present on the copy which can be associated with a particular make and model machine. Many copiers exhibited various types of black streaks or lines, especially on the reverse sides, which are apparently caused by rollers in the transport system within the machine. These lines are not considered especially significant because of the lack of consistency in the copies from one machine and the

TABLE 1—Manufacturers and models of copies received and studied.

Manufacturer	Model
Direct Electrostatic (Coated Paper)	
A. B. Dick Co.	650, Savin 200
Address-O-Graph Multigraph Corp.	AM2325, AM 5000
Apeco	110, 185, 186, 220, 285, 288, 289
Bell & Howell	Emissary I, Emissary II
Bohn Rex-Rotary	4601
Dennison Manufacturing Co.	Statesman, D.V.C., Copymaster, D.C. 101, Economist
Friden	1080, 1082, 1090
GAF	500, 600, 700, 800
Gestetner	C-10
ICP Division—OCE Industries	440, ADF 1200, 2100, AM 550
Minnesota Mining & Manufacturing Co. (3M)	Magne-Dry—235
Minolta	772, 1714
Nashua Corp.	120
Olivetti	205, 305, 405, Copia II, Copia III
Pitney-Bowes	250, 253, 258, 262, 363
Ricoh of Japan	Savin 220, Savin 230, 620, 675, 680, 626, Savin 215
Royfax Division of Litton Industries	1400, 1500, 1700, 1800
Saxon Business Products	B-12, C-35, C-500, CR-75, P-50
Smith Corona-Marchant	111, 142, 211, 412, 311R
Speed-O-Print	900, 1100, D.C. 17
Sperry Rand Corp.	A-3, BC-2, R-3
Toshiba	BD 25, BD 32A, BD 34A, OT 32
Yorktown Industries, Inc.	1114, 2000R
Indirect Electrostatic (Plain Paper)	
Agfa-Gevaert	Reprox 10
Canon, Inc.	6000
IBM	Copier I, Copier II
Konishiruko Photo Co., Inc., Ltd.	Royal Bond Copier, RBC II
Ricoh of Japan	Savin 300
Sperry Rand Corp.	Remington 530
Saxon Business Products	PPC-1
Van Dyk Research Corp.	4000
Xerox	660, 720, 813, 914, 1000, 2400, 3100, 3600 I, 3600 III, 4000, 7000
Thermal Copiers	
Copy-Rite Corp.	FC-7
Minnesota Mining & Manufacturing Co. (3M)	45-C (Thermofax)
Viewlex, Inc.	Viewfax 6B
Dual Spectrum	
Minnesota Mining & Manufacturing Co. (3M)	76, 117, 151, 271

presence of variations in the shape or size of the same type of lines on copies from different machines of the same model. A number of the direct electrostatic copies revealed, through the use of oblique lighting, the presence of indented lines or tracks in the coated surface on the front side of the copies. Again, these lines or tracks varied and apparently were caused by rollers in the transport system and, with one exception, were not considered significant. The exception is a copier manufactured by Dennison which will be discussed later.

The search for classifying characteristics was not entirely fruitless. Based on information supplied by the manufacturers and examinations of the copies received, characteristics were observed in copies from the following copiers which were consistent and unvarying to the point where they can be considered significant for classification.

### Direct Electrostatic

Olivetti Copia II and Copia IIR: Copies from these two machines exhibit white borders approximately 0.3 to 0.4 in. (7 to 10 mm) wide running lengthwise down the copy. In addition, if the original sheet being copied is somewhat smaller than the copy itself, a shaded area can be observed between the inner edge of the white border and the edge of the original sheet. The darkness of the shaded area will vary (Fig. 2).

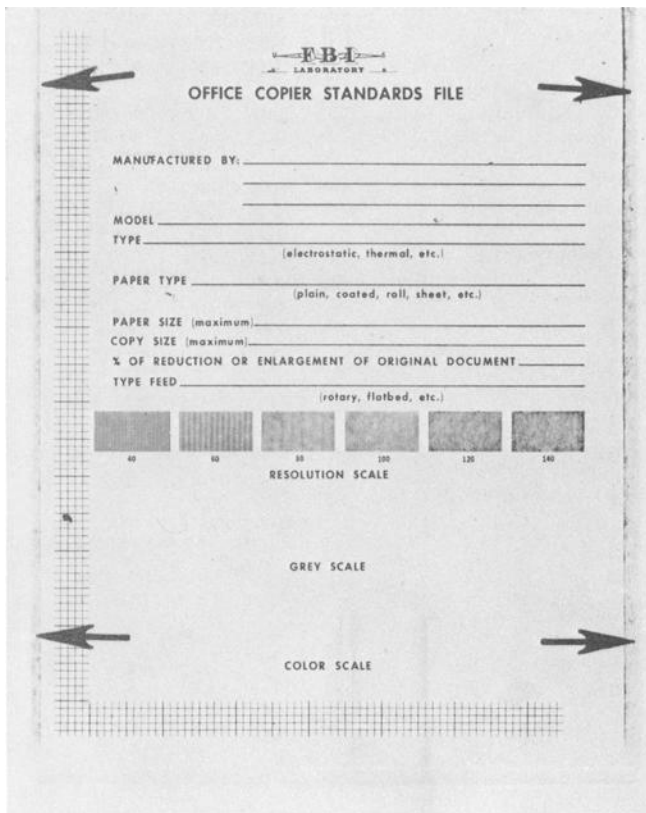


FIG. 2—Sample from an Olivetti Copia II or Copia IIR.

Royfax 1400: Copies from this machine will exhibit separator “finger” marks in both corners of the leading edge of the copy (leading edge refers to the edge of the copy exiting first from the machine) (Fig. 3).

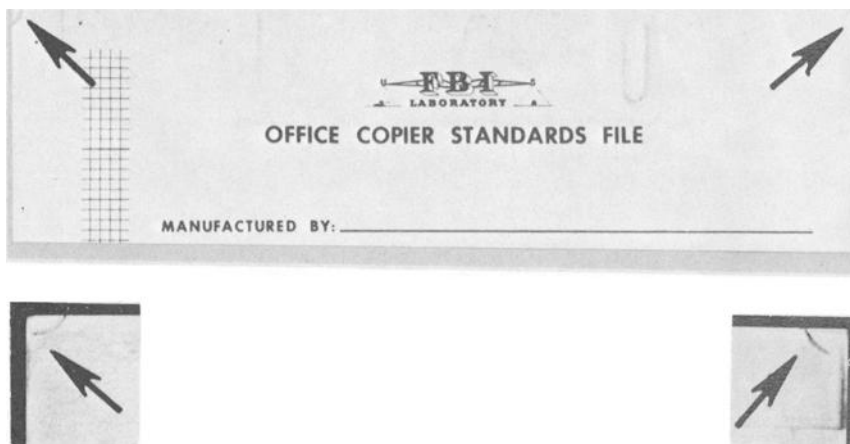


FIG. 3—Sample from a Royfax 1400. “Finger” marks in both corners of the leading edge of the copy are enlarged.

Dennison High Speed, Standard, and C.V.C.: The copies from these machines are characterized by indented roller tracks running lengthwise on the front side of the copies. These tracks are approximately 0.3 in. (7 mm) wide and approximately 4.8 in. (122 mm) apart. To date, these are the only copiers for which this characteristic is considered significant (Fig. 4).

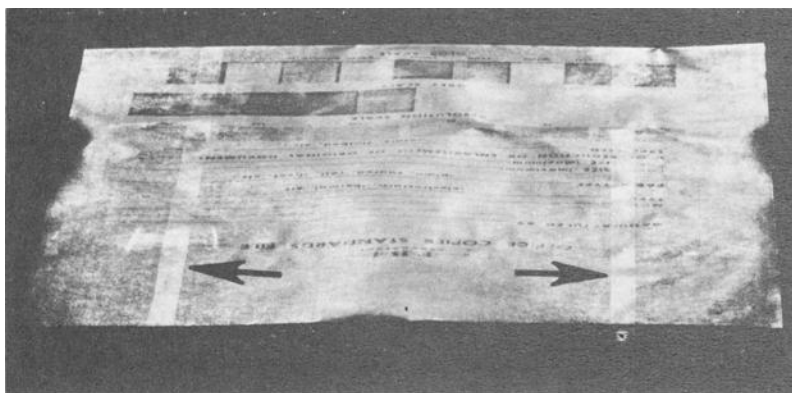


FIG. 4—Copies from Dennison High Speed, Standard, and C. V. C. machines show indented roller tracks running lengthwise on the front side of the copies.

#### Indirect Electrostatic

Xerox 660 and 813: Copies from these machines exhibit gripper marks indented into the top edge of the front side of the copy (Fig. 5).



FIG. 5—Samples from Xerox 660 and 813 show gripper marks indented into top edge of the front side of the copy.

Saxon PPC-1: Copies from this machine will show a white border along the top edge of the front side of approximately 0.3 to 0.4 in. (7 to 10 mm) wide. This white border will extend along the entire width of the copy (Fig. 6).

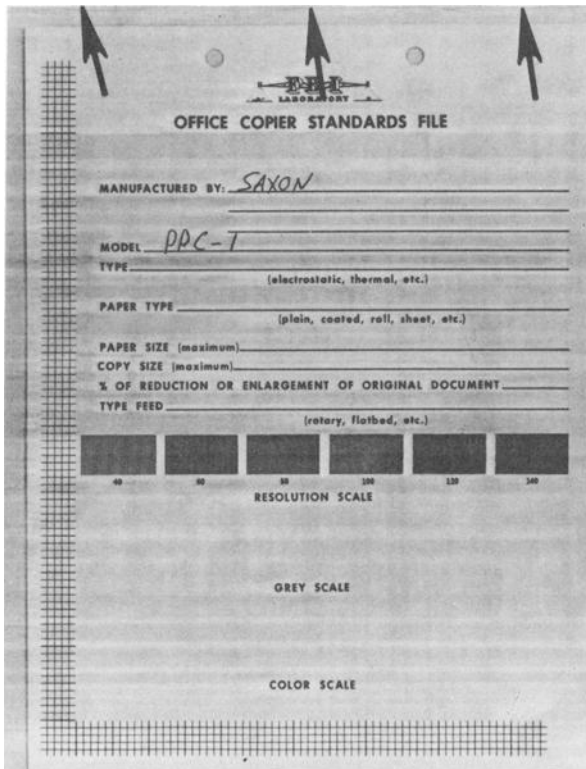


FIG. 6—Copies from a Saxon PPC-1 have a white border along the top edge of the front side.

Remington 530: Copies from this machine will exhibit gripper marks indented along the top edge of the copy. These marks differ in shape from those on copies from the

Xerox 660 and 813. The gripper marks on the Remington 530 are of a serrated configuration and are indented into the copy from the reverse side (Fig. 7).

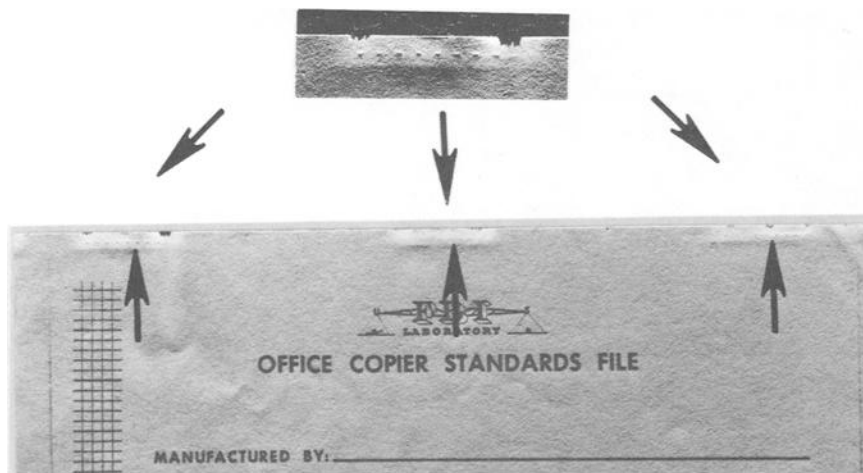


FIG. 7—Gripper marks indented along the top edge of the copy characterize copies from a Remington 530.

IBM Copier II: Copies from this machine normally will exhibit six parallel bands running across the width of the copy. These bands can be observed between the edge of the copy paper and the edge of the image of the original sheet being copied on either or both sides of the copy (Fig. 8). When the original sheet being copied is wider than the copy itself, these bands will not be observable. However, in most instances the original sheet probably will be narrower than the copy paper. In addition to the band markings, on occasion the air jets in the machines fail to remove the copy from the drum and a “picker” bar will remove the copy and leave an indentation on the copy (Fig. 9). Note that the figure represents a copy deliberately overexposed to demonstrate the picker bar marking. Normally, the mark will be somewhat lighter than is depicted.

### Dual Spectrum

3M: These copies are easily recognized by their slightly brown tone and by the appearance, on the reverse side, of a pink or blue tulip trademark.

Preliminary inquiry indicates that toners and paper for machines utilizing the same photocopying process are in some instances adaptable for use in other machines utilizing the same process, precluding classification based on materials. However, current plans include the use of instrumental and chemical examinations in an attempt to determine whether significant characteristics and identifiable differences exist between papers and toners.

Competition in the photocopying industry is intense and is resulting in a constant change in the number of different machines commercially available. Additionally, much information on processes and materials is proprietary in nature and not generally available. The need exists for further study and periodic updating that would assist

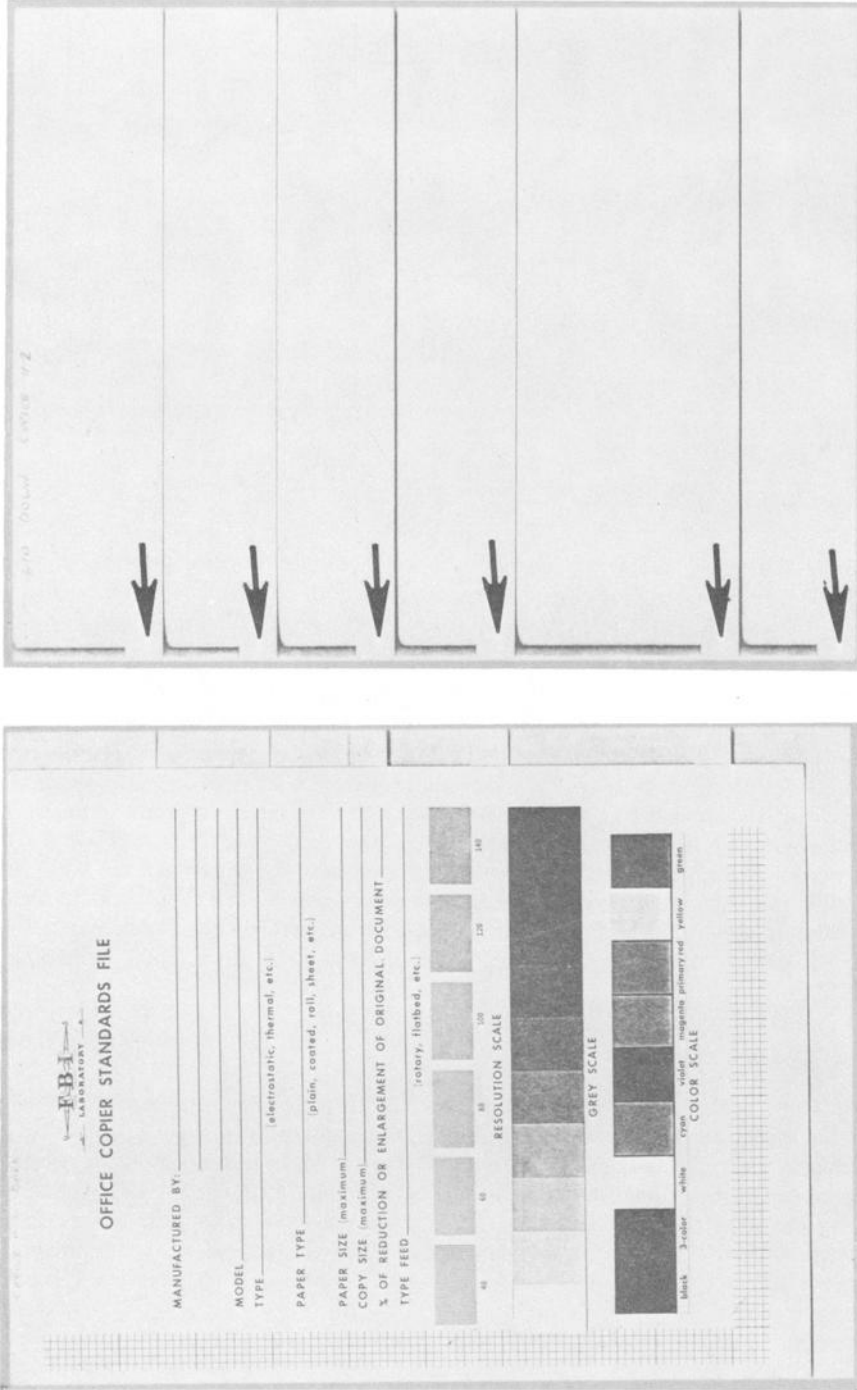


FIG. 8—Six parallel bands running across the width of the paper from an IBM Copier II (left) are detailed (right).



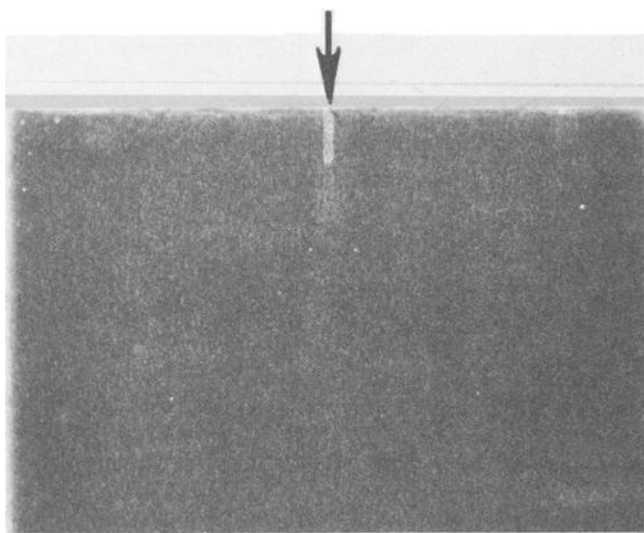


FIG. 9—Occasionally, marks from a “picker” bar can be seen on copies from an IBM Copier II.

examiners of questioned documents in classifying photocopied and properly assessing observable characteristics in photocopied which have value for identification purposes.

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