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1998-12-15

Information technology — Office equipment — Method for measuring copying machine productivity

Technologies de l'information — Équipement de bureau — Méthode de mesure de la productivité des machines à copier

Reference number
ISO/IEC 14545:1998(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 14545 was prepared by ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

Annex A of this International Standard is for information only.

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Information technology — Office equipment — Method for measuring copying machine productivity

1 Scope

This International Standard specifies a method for measuring the real output speed or “productivity” of copying machines. This International Standard is applicable to plain paper copying machines equipped with automatic document feeder or handling capability. This International Standard can be used for such machines run in either simplex or duplex copying modes. It is specifically intended for use with non-digital copiers, generally referred to as light-lens or analog devices. This International Standard allows comparison of the throughput copy rates for a machine operated in its various available duplexing modes.

Most copying machines produce duplex copies at a different rate than their nominal speed[1] when automatically feeding originals, and sorting and/or finishing the copies.

Duplex copy modes (1:2,2:1,2:2) are often used. In those modes, a reduction of effective copying speed is frequently clearly noticed.

The degree to which a reduction in productivity is experienced depends significantly on the type of document handler used on a machine. A document handler which presents originals to a copier platen in collated order for a single copy of each page to be made in sucession (precollating) can be provide a very different productivity from one which presents originals for copying of the full number of desired pages before the next original page in sequence is advanced to the platen for copying (postcollating). In addition, the effective productivity of a machine can be influenced by job related parameters, the most dominant of which are the number of originals in a set to be copied, and the run length, or number of copied sets to be produced. Existing standards, as well as common contemporary practices for measuring and reporting copying machine productivity do not adequately take into account these important machine and job related factors.

This International Standard provides a common method for measuring the real output speed or “productivity” when the above mentioned duplexing modes are used, and it allows manufacturers and buyers of copying machines to describe and compare the “productivity” of various copying machines equipped with such features.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 11159:1996, *Information technology — Office equipment — Minimum information to be included in specification sheets — Copying machines.*

American Society for Testing and Materials — ASTM F 1318-90 — "Standard Test Method for Determination of Productivity Using Electrostatic Copy Machines with Various Configurations".

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[1] Nominal copying speed as used herein refers to copies per minute produced in a continuous copying mode with an original stationary on the machine platen. Measurement of nominal copying shall be according to ISO/IEC 11159-2, parameter 5.1 Copying speed.

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3 Test conditions

3.1 Environment

The test(s) shall be performed in the following environment:

- Temperature: 18°C to 25°C
- Relative humidity: 30% to 70%

The copying machine shall be fully enclosed in its normal operation cover set. The machine and its full complement of supplies shall have been acclimated in this environment prior to conduct of the test(s). All supplies used in the test(s), including copy paper, shall be those specified by the manufacturer.

3.2 Voltage

The copying machine shall be connected to a voltage supply which remains within ± 10% of the nominal value of the specified operating voltage for the copying machine under test.

3.3 Copy paper

The paper used shall have the following characteristics:

- cutsheet
- A4 size
- weight: 60 g/m^2 to 90 g/m^2

4 Measuring method

4.1 Definitions

“Simplex copying”: This term is generic, and while less often used, it is the logical counterpart to the common term “duplexing” (see below). It describes the single most common specific operating mode:

1:1 mode: Simplex to simplex, or single-sided originals to single-sided copies.

“Duplexing”: This term is used to describe uses in which a copier can make a number of copies for a given number of originals, with information on one or both sides of the originals, and the copying being done to one or both sides of the copies. There is a one to one correspondence between originals and copies with regard to page content, but the three specific operating modes are each associated with more or less sheets of copied paper than original sheets of paper as follows:

1:2 mode: Simplex to duplex, or single-sided originals to two-sided copies

2:2 mode: Duplex to duplex, or two-sided originals to two-sided copies

2:1 mode: Duplex to simplex, or two-sided originals to single-sided copies

4.2 Measurements

4.2.1 General

The machine under test shall be preconditioned as in clause 3. The orientation of copy paper shall correspond to long edge feed, except in the instance when this feed orientation is not an attribute of the machine. In this latter case, short edge feed must be used, and this fact must be reported with the results of these tests.

The test(s) shall be done in the following modes, insofar as they are available on the machine of interest: 1:1, 1:2, 2:2, 2:1. Each test generates multiple sets of copies, as set forth in the following matrix table (Table 1, Productivity Run Matrix) of defined test conditions. The test requirements differ depending on the nominal speed of the copying machine. Examples of these test requirements and results are shown in Annex A.

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Table 1 — Productivity Run Matrix

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)		
		1	n_{50} (5 or 10 or 20)	n_{95}
4	1:1	R	R	R
4	1:2	R	R	R
4	2:2	R	R	R
4	2:1	R	R	R
10	1:1	R	R	R
10	1:2	R	R	R
10	2:2	R	R	R
10	2:1	R	R	R
20	1:1	R	R	R
20	1:2	R	R	R
20	2:2	R	R	R
20	2:1	R	R	R
> 20	1:1	O	O	O
> 20	1:2	O	O	O
> 20	2:2	O	O	O
> 20	2:1	O	O	O

R = required; O = optional

The following additional considerations apply to the use of Table 1.

Use of original set sizes, N_{55}, greater than 20, is optional, but may be employed if desired to demonstrate the characteristics of high productivity machines where the use of large sets is necessary to do so.

In general, a minimum of three run lengths is always required, according to these criteria:

a) Rung length = 1 is mandatory for any machine, regardless of nominal copy rate and / or productivity;

b) a Run length, n_{50}, near the 50% productivity point for the machine in each of its selected operating mode is required; whichever of the three designated Run lengths (5, 10 or 20 copied sets) most closely matches this 50 % point must be used;

c) a Run length, n_{95}, sufficiently long to measure the productivity point of the machine at ≥ 95% of maximum must be selected for each operating mode. If 95 % of maximum productivity is not attained within the Run length range of 5 - 20 copied sets, a longer Run length must be selected to achieve this condition.

The application of these three criteria to the selection of productivity data points are illustrated by the following additional considerations and reference to Annex A:

For each set size and copying mode,

1. measurement at Run length = 1 and 10 is required

2. if data at Run length = 10 is equivalent to n_{95}, then data at Run length = 5 is required;

3. if data for Run length = 10 is not equivalent to n95, then data for Run length = 20 is required;

4. if highest productivity is achieved at Set Size N, and Run length n both > 20, data for these conditions is not required.

Copies shall be made continuously, and shall not include special features as reduction, enlargement, automatic exposure or other output copy handling or finishing functions such as sorting or stapling. (The methods set forth here may be extended for assessment of the productivity impact such additional functions, by repeating the prescribed tests with those funcions activated.)

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The time required in each mode to product the completed copies is measured in seconds and recorded. For copiers which run in precollation mode, i.e., those equipped with a recirculating document handler, these time intervals may be measured sequentially during the course of a single run for a given original set size. For example, during a single run of 20 sets of a 10 page single-sided original, the lapsed time to produce 1, 10 and 20 sets of a 10 page single-sided original, the lapsed times to produce 1, 10 and 20 sets (or any number of sets within the run length range) may be measured sequentially as the run progresses. For copiers which run in a postcollatin mode, e.g., those equipped with automatic document handlers of feeders, it is necessary to conduct indepently and measure to completion each copy job for each of the required original set sizes. See the following sections 5 and 6 for data recording formats, treatment of data and presentation of results.

First copy out time (FCOT, as defined in ISO/IEC 11159) is included inherently in the measurements of overall multicopy speed to reflect the actual effective copy speed of a machine under test.

The time measurement is started when the “print” button is pressed, and is concluded when the last copy is fully ejected from the machine. These measurements are repeated, sufficient to assure that timing is reproducible within ± 5%. The measured intervals of time may be rounded off to the first place of integer accuracy.

5 Calculations and Treatment of Data

The time intervals measured to at least two significant figures during the course of a given run are recorded. A spreadsheet format which replicates Table 1, and shown below as Table 2. Time (secs) per Job, is useful for this purpose, but not required.

Table 2 — Time (secs) per Job

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)		
		1	n_{50} (5 or 10 or 20)	n_{95}
4	1:1			
10	1:1			
20	1:1			
> 20	1:1			
4	1:2			
10	1:2			
20	1:2			
> 20	1:2			
4	2:2			
10	2:2			
20	2:2			
> 20	2:2			
4	2:1			
10	2:1			
20	2:1			
> 20	2:1			

For each data element in the foregoing spreadsheet of measured data, an effective copy rate is calculated using the relationship:

$$S = 60 \times (N/T)$$

where

S = copies per minute

N = the total number of copy pages produced, and

T = measured time in seconds.

Copy rates so calculated are recorded in Table 3 below.

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6 Presentation of Results

The minimum required presentation of results is that displayed in Table 3, Copier Productivity (cpm).

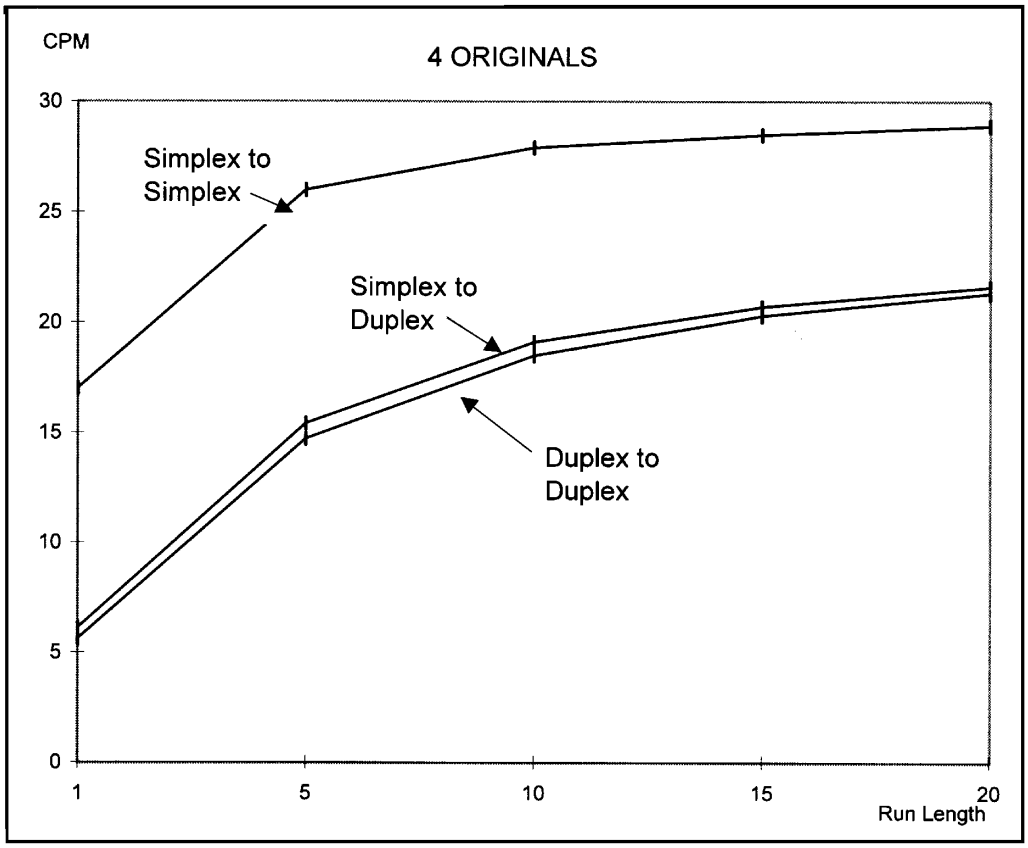
Table 3 — Copier Productivity (cpm)

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)		
		1	n_{50} (5 or 10 or 20)	n_{95}
4	1:1			
10	1:1			
20	1:1			
> 20	1:1			
4	1:2			
10	1:2			
20	1:2			
> 20	1:2			
4	2:2			
10	2:2			
20	2:2			
> 20	2:2			
4	2:1			
10	2:1			
20	2:1			
> 20	2:1			

The recommended, but not required, presentation is graphical, as shown below by example for one original set size in the Figure PRODUCTIVITY GRAPH. This mode of presentation allows rapid visual inspection and comparison of the performance differences within a given machine, and greatly facilitates the process of machine to machine comparison, when such are desired.

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1	5	10	15	20
17	26	27,9	28,5	28,9
6,1	15,4	19,1	20,7	21,6
5,6	14,7	18,5	20,3	21,3



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Annex A

(informative)

This Annex is provided for illustration purposes only. Presented are exemplary data for three machines, with normal copy rates of 30, 62 and 85 cps respectively. The data are presented so as to show use of the spreadsheet format of Table 2, and the reporting of results according to Table 2, and the reporting of results according to Table 3 and the PRODUCTIVITY GRAPH.

A.1. 30 CPM COPIER WITH AUTOMATIC DOCUMENT FEEDER AND DUPLEX CAPABILITY

Table 2 — Time (secs) per Job

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)											
		1	2	3	4	5	6	7	8	9	10	15	20
4	1:1	14	22	30	38	46	54	62	70	78	86	126	166
10	1:1	26	46	66	86	106	126	146	166	186	206	306	406
20	1:1	46	86	126	166	206	246	286	326	366	406	606	806
40	1:1	86	166	246	326	406	486	566	645	726	806	1206	1606
4	1:2	40	49	59	68	78	88	97	107	116	126	174	222
10	1:2	91	115	139	163	187	211	235	259	283	307	427	547
20	1:2	176	224	272	320	368	416	464	512	560	608	848	1088
40	1:2	346	442	538	634	730	826	922	1018	1114	1210	1690	2170
4	2:2	43	53	62	72	82	91	101	110	120	130	178	226
10	2:2	101	125	149	173	197	221	245	269	293	317	437	557
20	2:2	198	246	294	342	390	438	486	534	582	630	870	1110
40	2:2	392	488	584	680	776	872	968	1064	1160	1256	1736	2216

Table 3 — Copier Productivity (cpm)

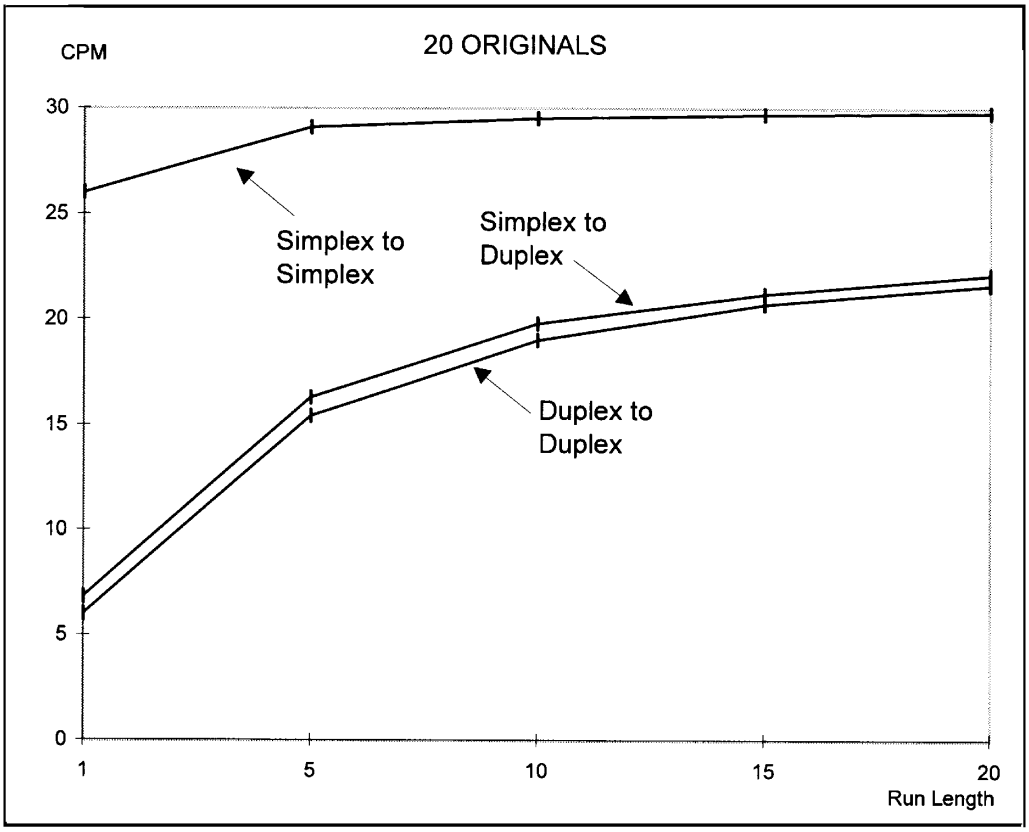
Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)											
		1	2	3	4	5	6	7	8	9	10	15	20
4	1:1	17.0	21.7	23.9	25.2	26.0	26.6	27.0	27.4	27.6	27.9	28.5	28.9
10	1:1	23.0	26.0	27.2	27.9	28.3	28.5	28.7	28.9	29.0	29.1	29.4	29.5
20	1:1	26.0	27.9	28.5	28.9	29.1	29.3	29.4	29.4	29.5	29.5	29.7	29.8
40	1:1	27.9	28.9	29.3	29.4	29.5	29.6	29.7	29.7	29.7	29.8	29.8	29.9
4	1:2	6.1	9.8	12.3	14.1	15.4	16.5	17.3	18.0	18.6	19.1	20.7	21.6
10	1:2	6.6	10.5	13.0	14.8	16.1	17.1	17.9	18.6	19.1	19.6	21.1	22.0
20	1:2	6.8	10.7	13.3	15.0	16.3	17.3	18.1	18.8	19.3	19.8	21.2	22.1
40	1:2	6.9	10.9	13.4	15.2	16.4	17.4	18.2	18.9	19.4	19.8	21.3	22.1
4	2:2	5.6	9.1	11.5	13.3	14.7	15.8	16.7	17.4	18.0	18.5	20.3	21.3
10	2:2	5.9	9.6	12.0	13.8	15.2	16.3	17.1	17.8	18.4	18.9	20.6	21.5
20	2:2	6.0	9.7	12.2	14.0	15.4	16.4	17.3	18.0	18.5	19.0	20.7	21.6
40	2:2	6.1	9.8	12.3	14.1	15.5	16.5	17.3	18.0	18.6	19.1	20.7	21.7

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PRODUCTIVITY GRAPH
30 cpm copier

1	5	10	15	20
26	29,1	29,5	29,7	29,8
6,8	16,3	19,8	21,2	22,1
6	15,4	19	20,7	21,6



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A.2. 62 CPM COPIER WITH AUTOMATIC DOCUMENT FEEDER AND DUPLEX CAPABILITY

Table 2 — Time (secs) per Job

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)											
		1	2	3	4	5	6	7	8	9	10	15	20
4	1:1	8	16	19	23	27	31	35	38	42	46	65	84
10	1:1	13	30	40	49	59	68	78	87	97	106	154	201
20	1:1	23	54	73	92	111	130	149	168	187	206	301	396
40	1:1	52	126	174	221	269	316	354	411	459	505	744	981
4	1:2	23	29	33	37	41	45	48	52	56	60	79	98
10	1:2	45	57	66	76	85	95	104	114	123	133	180	228
20	1:2	81	103	122	141	160	179	198	217	236	255	350	445
40	1:2	191	241	288	336	383	431	478	526	573	621	858	1096
4	2:2	16	22	26	30	34	38	41	45	49	53	72	91
10	2:2	35	47	57	66	76	85	95	104	114	123	171	218
20	2:2	67	88	107	126	145	164	183	202	221	240	335	430
40	2:2	162	212	259	307	354	402	449	497	354	592	829	1067

Table 3 — Copier Productivity (cpm)

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)											
		1	2	3	4	5	6	7	8	9	10	15	20
4	1:1	31.6	30.8	37.2	41.4	44.5	46.8	48.6	50.0	51.2	52.2	55.4	57.2
10	1:1	44.7	39.9	45.5	48.9	51.2	52.9	54.2	55.1	55.9	56.6	58.6	59.7
20	1:1	51.9	44.3	49.2	52.1	54.0	55.3	56.3	57.1	57.7	58.2	59.8	60.6
40	1:1	57.5	47.5	51.7	54.2	55.8	56.9	57.7	58.3	58.8	59.2	60.5	61.1
4	1:2	10.6	16.4	21.7	26.0	29.5	32.3	34.8	36.8	38.6	40.2	45.7	49.1
10	1:2	13.4	21.1	27.1	31.6	35.1	37.9	40.2	42.1	43.7	45.1	49.9	52.6
20	1:2	14.8	23.3	29.5	34.1	37.5	40.2	42.4	44.3	45.8	47.1	51.4	53.9
40	1:2	15.7	24.9	31.2	35.7	39.1	41.8	43.9	45.6	47.1	48.3	52.4	54.7
4	2:2	15.1	21.5	27.5	32.1	35.6	38.3	40.6	42.5	44.1	45.5	50.2	52.9
10	2:2	17.2	25.5	31.8	36.3	39.7	42.3	44.4	46.1	47.5	48.8	52.8	55.0
20	2:2	18.0	27.2	33.6	38.0	41.3	43.8	45.8	47.5	48.8	49.9	53.7	55.8
40	2:2	18.6	28.3	34.7	39.1	42.3	44.8	46.7	48.3	49.6	50.7	54.3	56.2

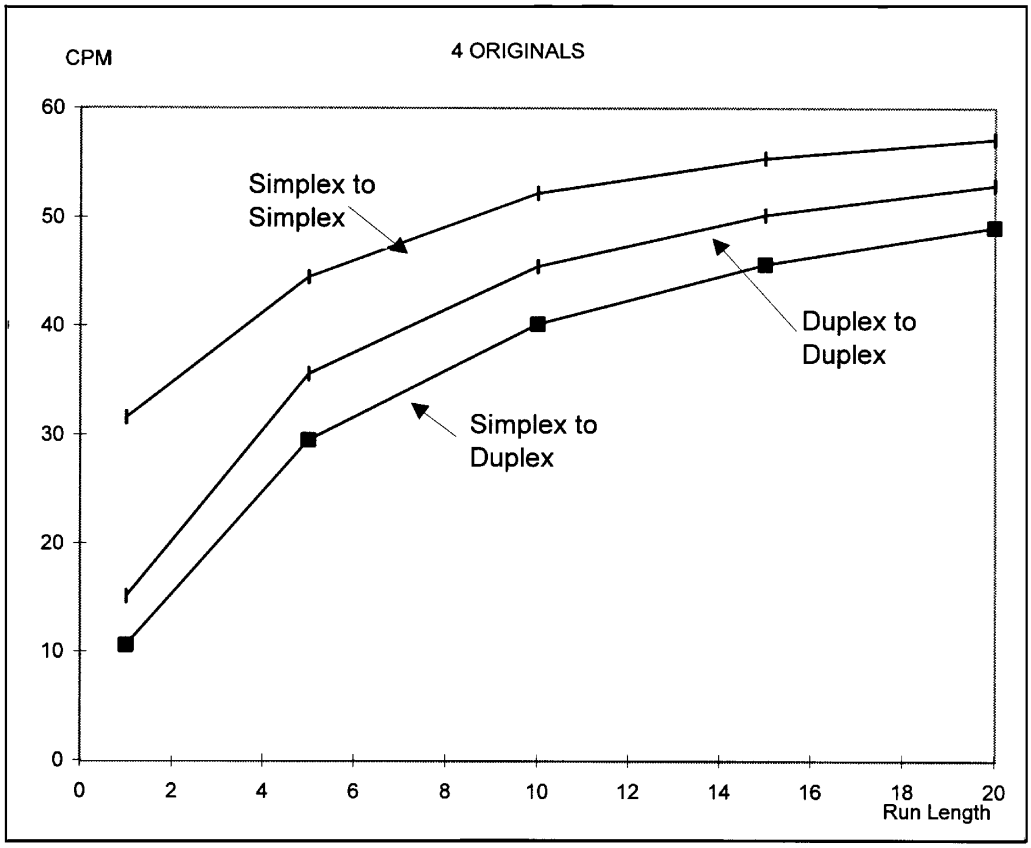
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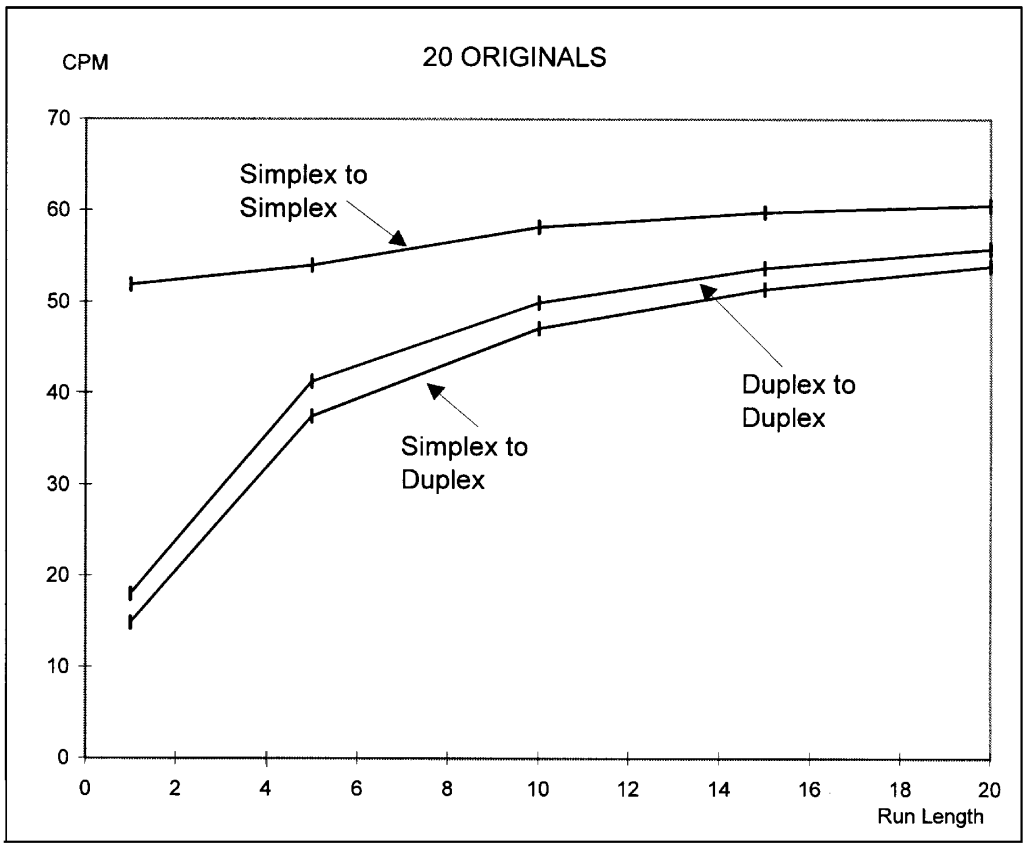
PRODUCTIVITY GRAPHS
62 cpm copier

1	5	10	15	20
31,6	44,5	52,2	55,4	57,2
10,6	29,5	40,2	45,7	49,1
15,1	35,6	45,5	50,2	52,9



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1	5	10	15	20
51,9	54	58,2	59,8	60,6
14,8	37,5	47,1	51,4	53,9
18	41,3	49,9	53,7	55,8



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A.2. 85 CPM COPIER WITH RECIRCULATING AUTOMATIC DOCUMENT FEEDER AND DUPLEX CAPABILITY

Table 2 — Time (secs) per Job

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)														
		1	2	3	4	5	6	7	8	9	10	15	20	45	50	100
4	1:1	8	12	15	18	21	24	27	30	32	35	50	65	150	164	323
10	1:1	12	24	32	39	46	54	61	68	75	83	119	156	358	394	779
20	1:1	20	45	59	74	89	103	118	132	147	162	235	308	704	777	1538
50	1:1	44	106	143	179	216	252	189	325	362	398	581	763	1742	1925	3817
4	1:2	24	27	30	33	36	39	42	45	48	51	66	81	198	213	405
10	1:2	53	61	68	76	83	91	98	106	113	121	158	196	475	513	980
20	1:2	103	118	133	148	163	178	193	208	223	238	313	388	938	1013	1938
50	1:2	250	287	325	362	400	437	475	512	550	587	775	962	2325	2512	4812
4	2:2	25	28	31	34	37	40	43	46	49	52	67	82	201	216	409
10	2:2	54	62	69	77	84	92	99	107	114	122	159	197	478	516	984
20	2:2	103	118	133	148	163	178	193	208	223	238	313	388	940	1015	1942
50	2:2	215	288	326	363	401	438	476	513	551	588	776	963	2327	2516	4816
100	2:2	496	571	646	721	796	871	946	1021	1096	1171	1546	1921	4639	5014	9606

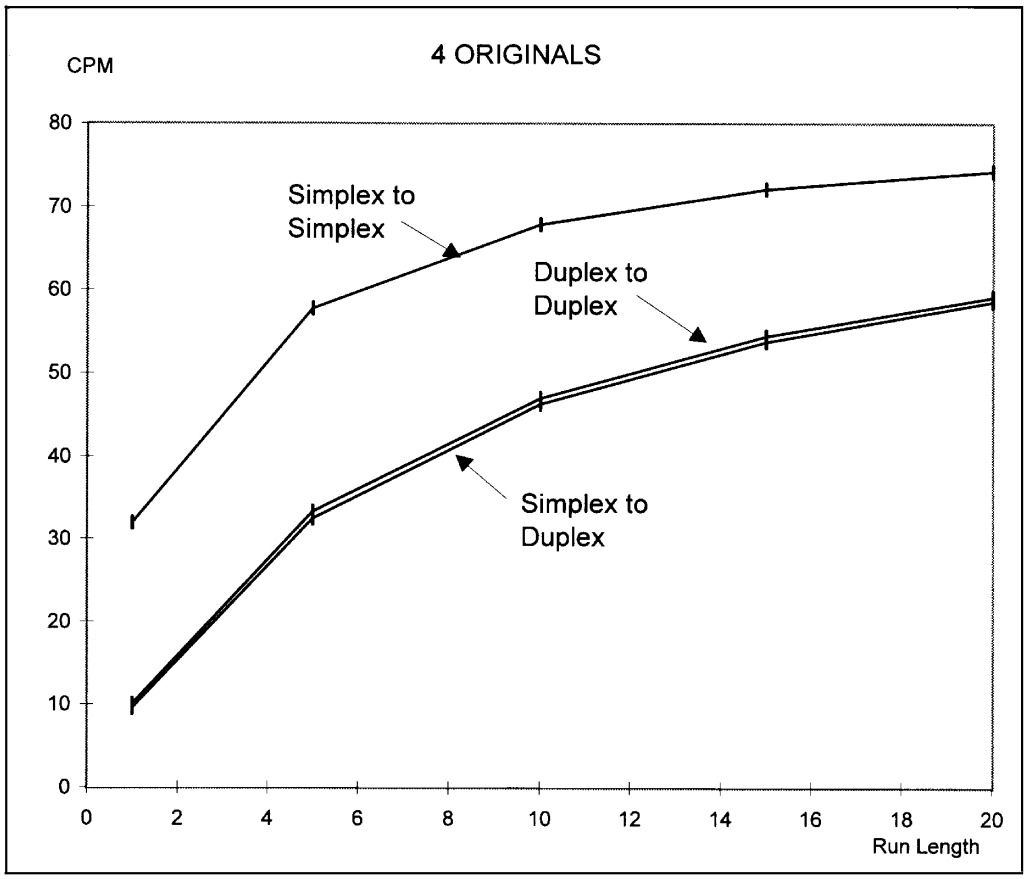
Table 3 — Copier Productivity (cpm)

Original Set Size, N_{55} (number of sides)	Copying mode	Run Length (Number of copied sets)														
		1	2	3	4	5	6	7	8	9	10	15	20	45	50	100
4	1:1	31.9	40.0	48.3	53.8	57.8	60.8	63.2	65.0	66.6	67.9	72.1	74.3	72.1	73.0	74.3
10	1:1	48.7	49.4	57.0	61.7	64.9	67.3	69.1	70.5	71.6	72.6	75.5	77.1	75.5	76.1	77.1
20	1:1	59.1	53.6	60.6	64.9	67.7	69.8	71.3	72.5	73.5	74.3	76.7	78.0	76.7	77.2	78.0
50	1:1	67.7	56.4	63.0	66.9	69.5	71.3	72.7	73.8	74.6	75.3	77.5	78.6	77.5	77.9	78.6
4	1:2	10.0	17.8	24.0	29.1	33.3	36.9	40.0	42.6	45.0	47.0	54.5	59.2	54.5	56.3	59.2
10	1:2	11.2	19.7	26.3	31.6	35.9	39.6	42.6	45.3	47.6	49.6	56.8	61.2	56.8	58.5	61.2
20	1:2	11.7	20.4	27.2	32.5	36.9	40.5	43.6	46.2	48.5	50.5	57.6	61.9	57.6	59.2	61.9
50	1:2	12.0	20.9	27.7	33.1	37.5	41.2	44.2	46.8	49.1	51.1	58.1	62.3	58.1	59.7	62.3
4	2:2	9.6	17.2	23.3	28.3	32.5	36.1	39.2	41.8	44.2	46.3	53.8	58.6	53.8	55.6	58.6
10	2:2	11.0	19.4	26.0	31.2	35.6	39.2	42.3	44.9	47.2	49.2	56.5	61.0	56.5	58.2	61.0
20	2:2	11.6	20.3	27.0	32.3	36.7	40.3	43.4	46.1	48.3	50.3	57.4	61.8	57.4	59.1	61.8
50	2:2	12.0	20.8	27.6	33.0	37.4	41.1	44.1	46.8	49.0	51.0	58.0	62.3	58.0	59.6	62.3
100	2:2	12.1	21.0	27.9	33.3	37.7	41.3	44.4	47.0	49.3	51.2	58.2	62.5	58.2	59.8	62.5

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PRODUCTIVITY GRAPHS
85 cpm copier

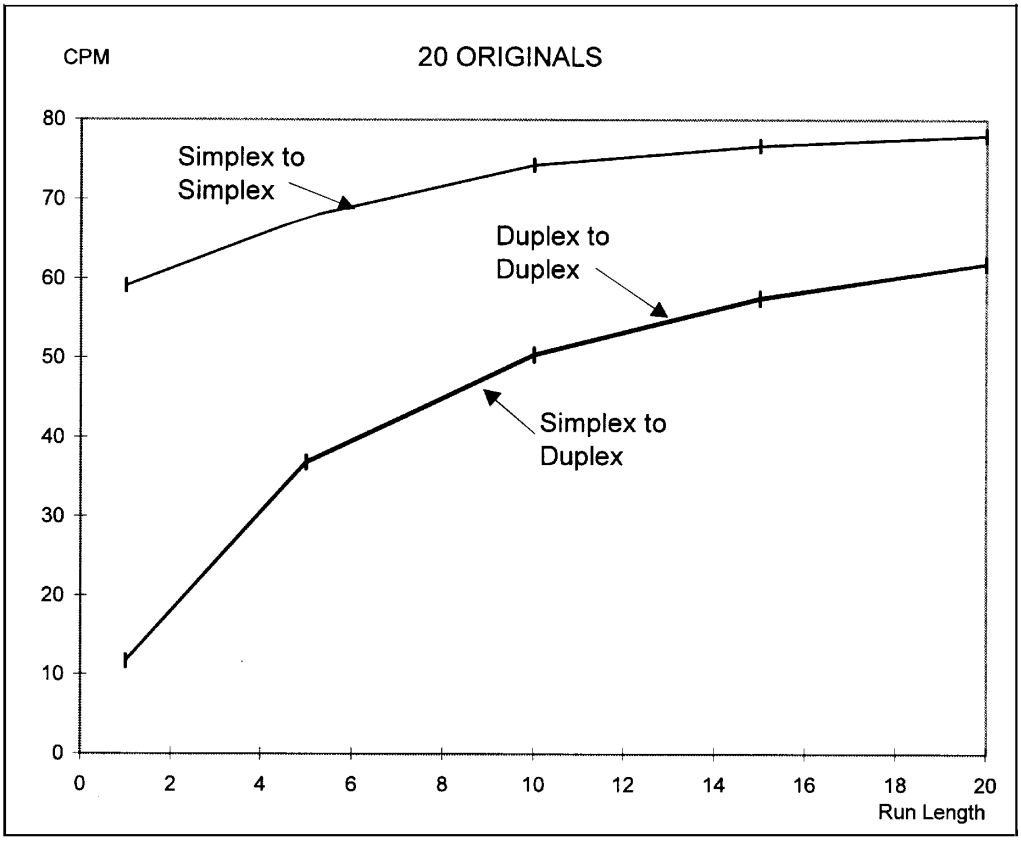
1	5	10	15	20	45	50	100
31,9	57,8	67,9	72,1	74,3	72,1	73	74,3
10	33,3	47	54,5	59,2	54,5	56,3	59,2
9,6	32,5	46,3	53,8	58,6	53,8	55,6	58,6



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1	5	10	15	20	45	50	100
59,1	67,7	74,3	76,7	78	76,7	77,2	78
11,7	36,9	50,5	57,6	61,9	57,6	59,2	61,9
11,6	36,7	50,3	57,4	61,8	57,4	59,1	61,8



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