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Watermarks

Hammermill® Bond is a premium number one sulphite watermarked paper containing 30% post-consumer recycled fiber. The Hammermill Bond watermark is:

- Cross direction
- Head-to-foot, left-to-right
- Random

Definitions

Cross direction

Right angles to the grain direction.

Head-to-foot, left-to-right

On a parent sheet, the watermarks generally run perpendicular to the paper grain. Final letterheads cut down are then grain long.

Random

Appears at least once in every 8½ x 11 sheet, in no particular location.

Standard Raised Watermark

The design is impressed with a dandy roll that has a raised surface pattern. This creates an area with less fiber making it lighter and more translucent.

How to Determine Ream Weights

The ream weight is the weight of 500 sheets.

Formula

$$\frac{\text{Given size x basis weight}}{\text{Area of basic size}} = \text{Ream weight}$$

Rounding Rules

Sheet Size	Ream Weight
864 inches ² or larger	Ream Weight rounded to nearest pound. (166 lbs.)
336 inches ² to 864 inches ²	Ream Weight rounded to nearest half pound. (165.5 lbs.)
Less than 336 inches ²	Ream Weight truncated to one hundredth of a pound. (165.66 lbs.)

Example

Find the ream weight of a sheet of 43 x 61, basis 60 lb. offset paper.

$$\frac{43 \times 61 \times 60}{25 \times 38} = \frac{157,380}{950} = 165.66 \longrightarrow 166 \text{ lb./ream}$$

Note: 25 x 38 is the basic size of offset paper.

Basic Sizes

Bond/Writing	17 x 22	= 374 square inches
Book and Offset	25 x 38	= 950 square inches
Tag	24 x 36	= 864 square inches
Index	25½ x 30½	= 778 square inches
Vellum Bristol	22½ x 28½	= 641 square inches
Coated Cover C2S	24 x 36	= 864 square inches
Coated Cover C1S	24 x 36	= 864 square inches
C1S Label	25 x 38	= 950 square inches
Opaque Cover	20 x 26	= 520 square inches

How to Determine Pages Per Inch

To determine the pages per inch (PPI), divide 2 by the caliper of the given sheet in .001".

Formula

$$\text{PPI} = \frac{2}{\text{Caliper (thousandths of an inch)}}$$

Example

$$\frac{2}{.0049} = 408 \text{ pages per inch.}$$

How to Determine M Weights

Folio Sheets

The ream weight is the weight of 500 sheets; the M weight is the weight of 1,000 sheets. The M weight can be obtained by first finding the ream weight, then multiplying by 2.

Cutsizes

The ream weight is the weight of 500 sheets; the M weight is the weight of 1,000 sheets. The M weight can be obtained by first finding the ream weight, then multiplying by 2.

Formula

$$\frac{\text{Given size} \times \text{basis weight}}{\text{Area of basic size}} = \text{Ream wgt.} \times 2 = \text{M weight}$$

How to Find the Weight of an Odd Number of Sheets

Formula

$$\frac{\text{Weight per M sheets} \times \text{no. of sheets}}{1,000} = \text{Total weight}$$

Example

What is the weight of 1,365 sheets, 25 x 38, 60lb. – 120M offset paper?

$$\frac{120 \times 1,365}{1,000} = 163.8\text{lb.}$$

How to Estimate the Weight of a Roll

To find the approx. weight of a roll, multiply roll diameter squared minus core diameter squared by roll width and appropriate factor.

Formula

$$(\text{Roll diameter}^2 - \text{core diameter}^2) = \text{Approximate weight of roll} \times \text{width of roll} \times \text{factor}$$

Example

Find the weight of a roll of Smooth Offset paper in a 40" diameter, 3" core, 35" width.

$$(40 \times 40 - 3 \times 3) \times 35 \times .022 = 1,225\text{lb.}$$

Factors

Vellum Offset	.020	Tag and Index	.026
Bond	.021	C1S Label	.030
Smooth Offset	.022	C2S Cover	.033
Vellum Bristol Cover	.022	C1S Cover & Blanks	.030

How to Determine the Density of a Sheet

To determine the density of any given sheet, divide the basis weight by the caliper.

Formula
 Density = $\frac{\text{Basis Weight}}{\text{Caliper}}$

How to Find the Linear Footage of a Roll of Paper

To find the approximate linear footage in a roll of paper, multiply the weight of the roll by the square inches of basic size. Then divide by the sum representing the width of the roll, multiplied by the substance or basis weight, times 12.

Formula

$$\frac{\text{Roll weight} \times \text{area of basic size} \times 500}{\text{Basis weight} \times \text{roll width} \times 12} = \text{Approximate* Linear Footage}$$

*Linear footage may vary based on finish of the sheet.

Example

Find the footage of a roll of basis 50lb. offset paper, 26" wide and weighing 100 lbs.

$$\frac{100 \times 25 \times 38 \times 500}{50 \times 26 \times 12} = 3,044 \text{ linear feet}$$

How to Determine Pieces Per Sheet

Write down the dimensions of the piece under the dimensions of the sheet, then divide both vertically and diagonally. The larger of the two numbers, disregarding fractions, is the answer.

Example

How many 5 x 8 cards can be cut from a 25½ x 30½ sheet?

Divide vertically	Then diagonally
$ \begin{array}{c} 25\frac{1}{2} \times 30\frac{1}{2} \dots\dots\dots \\ \updownarrow \quad \updownarrow \\ 5 \times 8 \\ \hline 5 \times 3 = 15 \text{ out} \end{array} $	$ \begin{array}{c} 25\frac{1}{2} \times 30\frac{1}{2} \\ \diagdown \quad \diagup \\ 5 \times 8 \\ \hline 6 \times 3 = 18 \text{ out} \end{array} $

Price Per Thousand Square Feet

(Price x basis weight) ÷ (RSI x .0006944444)

To find RSI:

Calculate the total number of square inches in one ream of the basic size for the grade.

RSI = basic length x basic width x 500

For Coated Cover Only (24 x 36 basic size)

Find MSF price:

MSF = \$ cwt. x basis weight ÷ 300

Find Cwt. price:

Cwt. = MSF x 300 ÷ basis weight

Price Per Thousand Sheets

Formula

$$\frac{\text{Cwt. price} \times \text{M weight}}{100} = \text{Price per 1,000 sheets}$$

Metric System

Sizes

Typical paper sizes converted from inches to millimeters.

Inches	Millimeters (Rounded)
8½	216
11	279
14	356
17	432
17½	445
19	483
20	508
22	559
22½	572
24	610
25	635
26	660
28	711
29	737
34	864
34½	876
35	889
42	1067
48	1219
50	1270
56	1422

1" = 25.4 millimeters

Converting Basis Weight

To convert basis weight to grams per square meter (GSM):

$$\frac{(\text{Basis weight}) (1406.15)}{\text{Basic size (in}^2\text{)}}$$

Basic Sizes

Bond 17 x 22 = 374 sq. in.

Book 25 x 38 = 950 sq. in.

Index

25½ x 30½ = 778 sq.in.

Vellum Bristol

22½ x 28½ = 641 sq. in.

Tag 24 x 36 = 864 sq. in.

Basis Weights and Grams Per Square Meter (GSM)

Pounds Per Ream	Grams/ Square Meter (GSM)
Basic size 17 x 22	
13	49
15	56
16	60
17	64
20	75
24	90
28	105
32	120
36	135
Basic size 22½ x 28½	
67	147
80	175
100	219
120	263
Basic size 25½ x 30½	
90	163
110	199
140	253
Basic size 24 x 36	
100	163
125	204
150	244
175	285
200	326
Basic size 25 x 38	
45	67
50	74
60	89
70	104
80	118
100	148
120	178

◀ **Example:**
28lb. 17 x 22 paper

$(28)(1406.15)$

17 in. x 22 in.

$$\frac{105 \text{ grams}}{\text{M}^2} = 105 \text{ GSM}$$

Cutting Chart

Chart showing page sizes and number of pages that are available from specific press sheet sizes.

Size of Page	Number of Pages	Size of Press Sheet	No. Printed Pages
9" x 12"	4	25" x 38"	4
	8		2
	16	38" x 50"	2
8 1/2" x 11"	4	23" x 35"	4
	8		2
	16	35" x 45"	2
5 1/2" x 7"	4		8
	8	23" x 29"	4
	16		2
6" x 9"	4		8
	8	25" x 38"	4
	16		2
	32	38" x 50"	2
5 1/2" x 8 1/2"	4		16
	8		8
	16	35" x 45"	4
	32		2
4 1/2" x 6"	4		16
	8		8
	16	25" x 38"	4
	32		2
4 1/4" x 5 3/8"	4		32
	8		16
	16	35" x 45"	8
	32		4
4" x 9"	4	25" x 38"	12
	8	38" x 50"	12
	12	25" x 38"	4
	16	38" x 50"	6
	24	25" x 38"	2

Temperature Condition Chart

Hours required to temperature-condition paper*

Cubic Volume of Paper on Skid or in Roll	Difference in Temperature of Paper and Temperature of Room in Which it is Opened							
	10°	15°	20°	25°	30°	40°	50°	60°
	(Hours paper should stand)							
6 cubic ft.	5	9	12	15	18	25	35	54
12 cubic ft.	8	14	18	22	27	38	51	78
24 cubic ft.	11	16	23	28	35	48	67	100
48 cubic ft.	14	19	26	32	38	54	75	109
96 cubic ft.	15	20	27	34	41	57	79	115

*Official Chart by the Graphic Arts Technical Foundation.

Paper Testing

Basis Weight

The designation given to a sheet of paper in terms of the weight of 500 sheets (one ream) in the standard size for that grade:

Offset – 25" x 38"

Reprographic – 17" x 22"

Tag – 24" x 36"

Vellum Bristol – 22½" x 28½"

Example: The basis weight of a typical grade of reprographic paper would be 20 lb. Bond (indicating 500 sheets, 17" x 22" weighing 20 lbs.).

Caliper

The caliper (or thickness) of paper at a given basis weight determines its bulk and is affected by processing done to obtain smoothness and porosity. Variations in caliper across the sheet will cause problems such as loose edges, baggy areas and misregister.

Caliper is measured by a micrometer having a foot diameter of 5/8" which is clamped against the sheet as 7 p.s.i. pressure. Results are reported in thousandths of an inch.

A caliper reading is usually the average of several tests across the sheet.

Smoothness

The smoothness is a measure of paper surface irregularities. The property affects many end uses, particularly the appearance of printing. The test is conducted by clamping the paper against a flat surface and measuring rate of air flow passing between the two surfaces. The Sheffield instrument is most commonly used, a higher number indicating a rougher sheet. Some typical smoothness values are: 10–30 for very smooth paper; 100–150 for smooth paper and 200–250 for vellum paper.

Porosity

The porosity is an indication of the openness of paper, as measured by resistance to the passage of air through the sheet.

Two types of instruments are generally used to measure porosity – Gurley and Sheffield. The Gurley instrument measures the seconds required for a given volume of air to pass through a single sheet and is generally used for porous papers. A high reading indicates a less porous (or more dense) paper. Sheffield porosity measures the flow rate of air through a single sheet and is generally used for non-porous or dense sheets. A high Sheffield reading indicates a more open paper. A typical Gurley porosity test for 50 lb. smooth offset would be 10–20 seconds.

Moisture

The moisture content of paper is affected by both the drying conditions when made and the relative humidity environment in which it is used. Ideally, paper should be made with a moisture content in equilibrium with the relative humidity where it will be used. Of course, environmental conditions vary at different places and times of the year. Ideal conditions seldom occur. If paper is drier than its environment, it will pick up moisture; and if lower it will lose moisture. Under extreme differences, these changes in moisture level will cause dimensional changes in the paper and cause problems such as curl, warp and waviness. Ideally, paper is in balance with an environment of 74°F and 50% relative humidity.

To achieve accurate and reproducible results, exacting test procedures are followed to determine paper moisture. The sample is weighed, dried in an oven at 105°C and then weighed dry. The difference in weight is the amount of water in the sheet removed by drying. Paper is generally made to contain between 4% and 7% moisture.

Wax Pick

(Dennison) is a measurement of paper surface strength. This test evaluates surface bonding strength and relates to the tendency for tacky inks to pick fibers or particles from paper surface.

To test for these properties, a series of waxes of varying hardness are melted, placed on the sample, and, after cooling pulled off. The softest wax (lowest number) that removes surface fibers designates wax pick number. A typical wax pick range for uncoated printing papers is 10–12.

Brightness and Whiteness

Aside from its aesthetic importance, paper brightness affects the legibility and contrast of printing. The brightness test measures the reflectance of paper under strict optical conditions and relates it to a white standard (Magnesium Oxide). This test is mainly applicable to white paper grades.

What is Whiteness?

The absence of other colors in white makes for good contrast with printed color combinations. Cream shaded papers are not favored as they are associated with aging and fading. People favor papers with a slight shift to the blue shade which they associate with newness, freshness and cleanliness. International Paper's introduction of whiteness through its VIP Technologies™ assures the highest benefit under the most economical conditions – greater value to you and your customers. For uniformity across all uncoated white paper grades, International Paper has standardized on the globally accepted CIE 145 whiteness.

What is Important – Whiteness or Brightness?

If you want to have more impact – focus on whiteness.

Whiteness is more important and accurate with regard to the human perception of quality and uniformity of paper than is brightness. Whiteness is the best descriptor of the appearance of white paper.

Opacity

Opacity is the lack of transparency that allows a sheet to conceal print on its reverse side. Opacity is greatly influenced by basis weight, brightness, type of fiber and filler. In testing, reflectance of paper is measured when backed successfully by a white body and a black body. The ratio of these two measurements determines the opacity reading.

Standard Paper Sizes

As trade continues its global expansion, international interoffice communication via fax machines and copiers will increase. As a result, the use of European and Japanese paper sizes will probably increase, too.

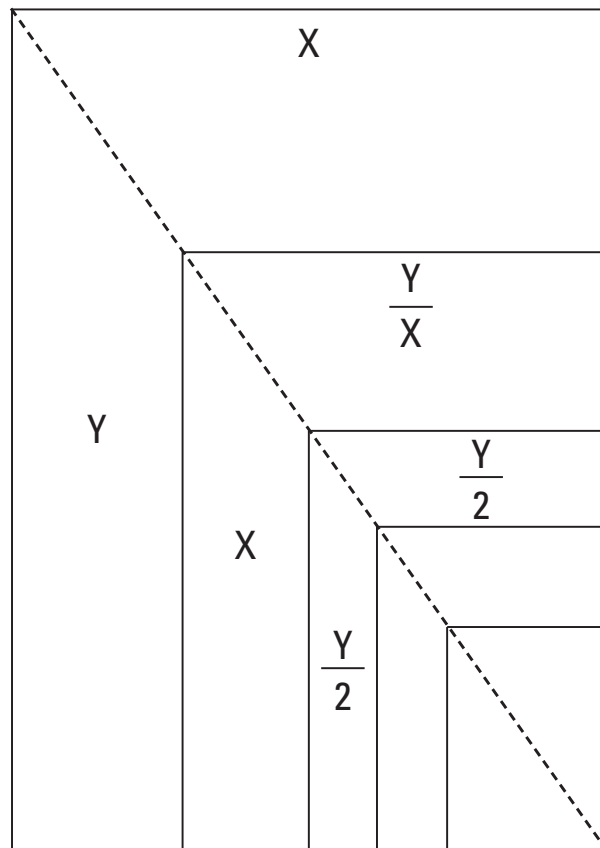
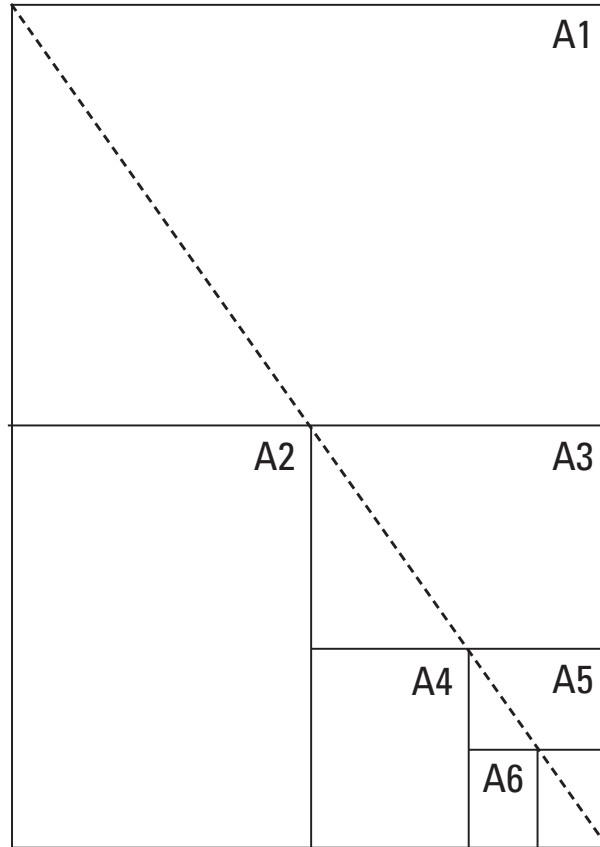
In Europe and Japan, paper sizes follow the metric standard and are referred to as ISO or JIS “A” series. One advantage in using this sizing is that each size in the “A” range is half the area of the preceding size (the squared dimensions), but the proportions remain the same (see diagrams next page).

This facilitates the photographic enlargement or reduction of illustrations and all text within the range of sizes. The range is suitable for all reprographic processes. The A4 size normally is used for trade literature, government publications, journals, specifications, bills of lading, letterheads and contracts.

Some countries also use the JIS “B” series. “B” series sized papers are normally intended for posters or other items such as wall charts, where the difference in size of the larger sheets in the “A” series represents too large a jump.

The chart on page 133 gives a comparison of the standard sizes of paper.

Standard Paper Sizes Relationship



See page 131 for an explanation of charts.

Standard Paper Sizes Relationship

Designation	U.S. Standard		European ISO and JIS "A" Series			Japanese JIS "B" Series		
	Size		Designation	Size		Designation	Size	
	mm	Inches		mm	Inches		mm	Inches
	889 x 1,575	35 x 45	A0	841 x 1,189	33.1 x 46.8	B0	1,030 x 1,456	40.6 x 57.3
	584 x 889	23 x 35	A1	594 x 841	23.4 x 33.1	B1	728 x 1,030	28.7 x 40.6
	432 x 559	17 x 22	A2	420 x 594	16.5 x 23.4	B2	515 x 728	20.3 x 28.7
Ledger	279 x 432	11 x 17	A3	297 x 420	11.7 x 16.5	B3	364 x 515	14.3 x 20.3
Legal	—	8.5 x 14						
Letter	216 x 279	8.5 x 11	A4	210 x 297	8.3 x 11.7	B4	257 x 364	10.1 x 14.3
Monarch	—	7.25 x 10.5						
Executive/Half/ Statement	140 x 216	5.5 x 8.5	A5	148 x 210	5.8 x 8.3	B5	182 x 257	7.2 x 10.1
	108 x 140	4.25 x 5.5	A6	105 x 148	4.1 x 5.8	B6	128 x 182	5.0 x 7.2
	89 x 108	3.5 x 4.25	A7	74 x 105	2.9 x 4.1	B7	91 x 128	3.6 x 5.0

Please see page 131 for an explanation of these charts.

Equivalent Weights

In reams (500 sheets); basis weights in bold type.

Book/ Offset 25 x 38	Bond/ Writing 17 x 22	Cover 20 x 26	Bristol 22½ x 28½	Index 25½ x 30½	Tag 24 x 36	Metric Grams Per Sq. Meter
Book and Offset						
30	12	16	20	25	27	44
40	16	22	27	33	36	59
45	18	25	30	37	41	67
50	20	27	34	41	45	74
60	24	33	41	49	55	89
70	28	38	47	57	64	104
80	31	44	54	65	73	118
90	35	49	61	74	82	133
100	39	55	68	82	91	148
120	47	66	81	98	109	178
Bond/Writing						
33	13	18	22	27	30	49
41	16	22	27	33	37	60
51	20	28	34	42	46	75
61	24	33	41	50	55	90
71	28	39	48	58	65	105
81	32	44	55	67	74	120
91	36	50	62	75	83	135
102	40	56	69	83	92	150
Cover						
91	36	50	62	75	83	135
110	43	60	74	90	100	162
119	47	65	80	97	108	176
146	58	80	99	120	133	216
164	65	90	111	135	150	243
183	72	100	123	150	166	271
Vellum Bristol						
99	39	55	67	81	90	147
119	47	65	80	97	108	175
148	58	81	100	121	135	219
178	70	97	120	146	162	263
207	82	114	140	170	189	307
237	93	130	160	194	216	351
Index						
110	43	60	74	90	100	163
135	53	74	91	110	122	199
170	67	94	115	140	156	253
207	82	114	140	170	189	307
Tag						
110	43	60	74	90	100	163
137	54	75	93	113	125	203
165	65	90	111	135	150	244
192	76	105	130	158	175	285
220	87	120	148	180	200	326
275	108	150	186	225	250	407