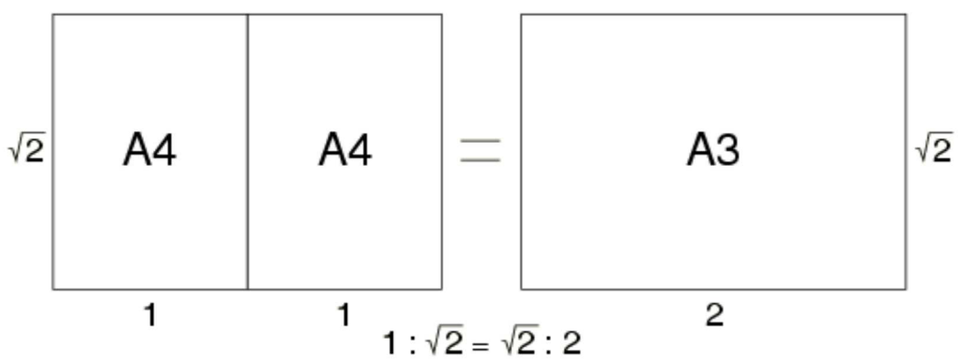
International standard paper sizes

by Markus Kuhn

Standard paper sizes like ISO A4 are widely used all over the world today. This text explains the ISO 216 paper size system and the ideas behind its design.

The ISO paper size concept

In the ISO paper size system, the height-to-width ratio of all pages is the square root of two (1.4142 : 1). In other words, the width and the height of a page relate to each other like the side and the diagonal of a square. This aspect ratio is especially convenient for a paper size. If you put two such pages next to each other, or equivalently cut one parallel to its shorter side into two equal pieces, then the resulting page will have again the same width/height ratio.



The ISO paper sizes are based on the metric system. The square-root-of-two ratio does not permit both the height and width of the pages to be nicely rounded metric lengths. Therefore, the area of the pages has been defined to have round metric values. As paper is usually specified in g/m², this simplifies calculation of the mass of a document if the format and number of pages are known.

ISO 216 defines the **A series** of paper sizes based on these simple principles:

- The height divided by the width of all formats is the square root of two (1.4142).
- Format A0 has an area of one square meter.
- Format A1 is A0 cut into two equal pieces. In other words, the height of A1 is the width of A0 and the width of A1 is half the height of A0.
- All smaller A series formats are defined in the same way. If you cut format A*n* parallel to its shorter side into two equal pieces of paper, these will have format A(*n*+1).
- The standardized height and width of the paper formats is a rounded number of millimeters.

For applications where the ISO A series does not provide an adequate format, the **B series** has been introduced to cover a wider range of paper sizes. The **C series** of formats has been defined for envelopes.

- The width and height of a B*n* format are the *geometric mean* between those of the A*n* and the next larger A($n-1$) format. For instance, B1 is the geometric mean between A1 and A0, that means the same magnification factor that scales A1 to B1 also scales B1 to A0.
- Similarly, the formats of the C series are the geometric mean between the A and B series formats with the same number. For example, an (unfolded) A4 size letter fits nicely into a C4 envelope, which in turn fits as nicely into a B4 envelope. If you fold this letter once to A5 format, then it will fit nicely into a C5 envelope.
- B and C formats naturally are also square-root-of-two formats.

Note: The *geometric mean* of two numbers x and y is the square root of their product, $(xy)^{1/2}$, whereas their *arithmetic mean* is half their sum, $(x+y)/2$. For example, the geometric mean of the numbers 2 and 8 is 4 (because 4/2 = 8/4), whereas their arithmetic mean is 5 (because 5−2 = 8−5). The arithmetic mean is half-way between two numbers by addition, whereas the geometric mean is half-way between two numbers by multiplication.

By the way: The Japanese JIS P 0138-61 standard defines the same A series as ISO 216, but a slightly different B series of paper sizes, sometimes called the JIS B or JB series. JIS B0 has an area of 1.5 m², such that the area of JIS B pages is the *arithmetic mean* of the area of the A series pages with the same and the next higher number, and not as in the ISO B series the *geometric mean*. For example, JB3 is 364 × 515, JB4 is 257 × 364, and JB5 is 182 × 257 mm. Using the JIS B series should be avoided. It introduces additional magnification factors and is not an international standard.

The following table shows the width and height of all ISO A and B paper formats, as well as the ISO C envelope formats. The dimensions are in millimeters:

A Series Formats		B Series Formats		C Series Formats	
4A0	1682 × 2378	–	–	–	–
2A0	1189 × 1682	–	–	–	–
A0	841 × 1189	B0	1000 × 1414	C0	917 × 1297
A1	594 × 841	B1	707 × 1000	C1	648 × 917
A2	420 × 594	B2	500 × 707	C2	458 × 648
A3	297 × 420	B3	353 × 500	C3	324 × 458
A4	**210 × 297**	B4	250 × 353	C4	229 × 324
A5	148 × 210	B5	176 × 250	C5	162 × 229
A6	105 × 148	B6	125 × 176	C6	114 × 162
A7	74 × 105	B7	88 × 125	C7	81 × 114
A8	52 × 74	B8	62 × 88	C8	57 × 81
A9	37 × 52	B9	44 × 62	C9	40 × 57
A10	26 × 37	B10	31 × 44	C10	28 × 40

The allowed tolerances are ±1.5 mm for dimensions up to 150 mm, ±2 mm for dimensions above 150 mm up to 600 mm, and ±3 mm for dimensions above 600 mm. Some national equivalents of ISO 216 specify tighter tolerances, for instance DIN 476 requires ±1 mm, ±1.5 mm, and ±2 mm respectively for the same ranges of dimensions.

Application examples

The ISO standard paper size system covers a wide range of formats, but not all of them are widely used in practice. Among all formats, A4 is clearly **the** most important one for daily office use. Some main applications of the most popular formats can be summarized as:

A0, A1	technical drawings, posters
A1, A2	flip charts
A2, A3	drawings, diagrams, large tables
A4	letters, magazines, forms, catalogs, laser printer and copying machine output
A5	note pads
A6	postcards
B5, A5, B6, A6	books
C4, C5, C6	envelopes for A4 letters: unfolded (C4), folded once (C5), folded twice (C6)
B4, A3	newspapers, supported by most copying machines in addition to A4
B8, A8	playing cards

The main advantage of the ISO standard paper sizes becomes obvious for users of copying machines:

Example 1:

You are in a library and want to copy an article out of a journal that has A4 format. In order to save paper, you want copy two journal pages onto each sheet of A4 paper. If you open the journal, the two A4 pages that you will now see together have A3 format. By setting the magnification factor on the copying machine to 71% (that is sqrt(0.5)), or by pressing the **A3→A4** button that is available on most copying machines, both A4 pages of the journal article together will fill **exactly** the A4 page produced by the copying machine. One reproduced A4 page will now have A5 format. No wasted paper margins appear, no text has been cut off, and no experiments for finding the appropriate magnification factor are necessary. The same principle works for books in B5 or A5 format.

Copying machines designed for ISO paper sizes usually provide special keys for the following frequently needed magnification factors:

71%	sqrt(0.5)	A3 → A4
84%	sqrt(sqrt(0.5))	B4 → A4
119%	sqrt(sqrt(2))	A4 → B4 (also B5 → A4)
141%	sqrt(2)	A4 → A3 (also A5 → A4)

The magnification factors between all A sizes:

from \ to	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A0	100%	71%	50%	35%	25%	18%	12.5%	8.8%	6.2%	4.4%	3.1%
A1	141%	100%	71%	50%	35%	25%	18%	12.5%	8.8%	6.2%	4.4%
A2	200%	141%	100%	71%	50%	35%	25%	18%	12.5%	8.8%	6.2%
A3	283%	200%	141%	100%	71%	50%	35%	25%	18%	12.5%	8.8%
A4	400%	283%	200%	141%	100%	71%	50%	35%	25%	18%	12.5%
A5	566%	400%	283%	200%	141%	100%	71%	50%	35%	25%	18%
A6	800%	566%	400%	283%	200%	141%	100%	71%	50%	35%	25%

A7	1131%	800%	566%	400%	283%	200%	141%	100%	71%	50%	35%
A8	1600%	1131%	800%	566%	400%	283%	200%	141%	100%	71%	50%
A9	2263%	1600%	1131%	800%	566%	400%	283%	200%	141%	100%	71%
A10	3200%	2263%	1600%	1131%	800%	566%	400%	283%	200%	141%	100%

Not only the operation of copying machines in offices and libraries, but also repro photography, microfilming, and printing are simplified by the 1:sqrt(2) aspect ratio of ISO paper sizes.

Example 2:

If you prepare a letter, you will have to know the weight of the content in order to determine the postal fee. This can be very conveniently calculated with the ISO A series paper sizes. Usual typewriter and laser printer paper weighs 80 g/m². An A0 page has an area of 1 m², and the next smaller A series page has half of this area. Therefore, the A4 format has an area of 1/16 m² and weighs with the common paper quality 5 g per page. If we estimate 20 g for a C4 envelope (including some safety margin), then you will be able to put 16 A4 pages into a letter before you reach the 100 g limit for the next higher postal fee.

Calculation of the mass of books, newspapers, or packed paper is equally trivial. You probably will not need such calculations often, but they nicely show the beauty of the concept of metric paper sizes.

Using standard paper sizes saves money and makes life simpler in many applications. For example, if all scientific journals used only ISO formats, then libraries would have to buy only very few different sizes for the binders. Shelves can be designed such that standard formats will fit in exactly without too much wasted shelf volume. The ISO formats are used for surprisingly many things besides office paper: the German citizen ID card has format A7, both the European Union and the U.S. (!) passport have format B7, and library microfiches have format A6. In some countries (e.g., Germany) even many brands of toilet paper have format A6.

Further details

Calculating the dimensions

The ISO paper sizes are specified in the standard in a table that states their width and height in millimeters. Following the principles described above, the dimensions could be calculated with the following formulas:

Format	Width [m]	Height [m]
An	$2^{-1/4-n/2}$	$2^{1/4-n/2}$
Bn	$2^{-n/2}$	$2^{1/2-n/2}$
Cn	$2^{-1/8-n/2}$	$2^{3/8-n/2}$

However, the actual millimeter dimensions in the standard have been calculated instead by using the above values only at n = 0, and then progressively dividing these values by two to obtain the smaller sizes, each time rounding the result to the next lower integer number of millimeters (floor function). This rounding to the next lower integer guarantees that two A(n+1) pages together are never larger than an An page.

The following programs demonstrate this algorithm in several programming languages:

- iso-paper.c – C version

- iso-paper.py – Python version

Aspect ratios other than sqrt(2)

Sometimes, paper formats with a different aspect ratio are required for labels, tickets, and other purposes. These should preferably be derived by cutting standard series sizes into 3, 4, or 8 equal parts, parallel with the shorter side, such that the ratio between the longer and shorter side is greater than the square root of two. Some example long formats in millimeters are:

1/3 A4	99 × 210
1/4 A4	74 × 210
1/8 A4	37 × 210
1/4 A3	105 × 297
1/3 A5	70 × 148

The 1/3 A4 format (99 × 210 mm) is also commonly applied for reduced letterheads for short notes that contain not much more than a one sentence message and fit without folding into a DL envelope.

Envelope formats

For postal purposes, ISO 269 and DIN 678 define the following envelope formats:

Format	Size [mm]	Content Format
C6	114 × 162	A4 folded twice = A6
DL	110 × 220	A4 folded twice = 1/3 A4
C6/C5	114 × 229	A4 folded twice = 1/3 A4
C5	162 × 229	A4 folded once = A5
C4	229 × 324	A4
C3	324 × 458	A3
B6	125 × 176	C6 envelope
B5	176 × 250	C5 envelope
B4	250 × 353	C4 envelope
E4	280 × 400	B4

The DL format is the most widely used business letter format. DL probably originally stood for "DIN lang", but ISO 269 now explains this abbreviation instead more diplomatically as "Dimension Lengthwise". Its size falls somewhat out of the system and equipment manufacturers have complained that it is slightly too small for reliable automatic enveloping. Therefore, DIN 678 introduced the C6/C5 format as an alternative for the DL envelope.

Window envelopes, A4 letterheads, folding marks and standard layouts

There exists no international standard yet for window envelopes and matching letterhead layouts. There are various incompatible national standards, for example:

- **Germany:** DIN 680 specifies that a transparent address window is 90 × 45 mm large and its left edge should be located 20 mm from the left edge of the envelope. For C6, DL, and C6/C5 envelopes, the bottom edge of the window should be 15 mm from the bottom edge of the envelope. For C4 envelopes, the top edge of the window should be either 27 or 45 mm from the top edge of the envelope. The

letterhead standard DIN 676 does not specify the actual content or form of a pre-printed letterhead, it only specifies zones for the location of certain elements. The letterhead format specified in DIN 676 has a 85 × 45 mm large address field visible through the window, in which the top 5 mm are reserved for printing in a small font the sender's address and the bottom 40 mm are for writing the recipient's address. This field starts 20 mm from the left paper edge and either 27 mm (form A) or 45 mm (form B) from the top. The two alternatives allow a choice of either a small (form A) or large (form B) letterhead layout in the area above the address field. Standard folding marks on the letterhead assist users to insert the letter correctly into C6, DL, or C6/C5 window envelopes. There is one folding mark (for C6) on the top edge of the page, 148 mm from the left edge. There are also two folding marks on the left edge of the page, either 105 and 210 mm from the bottom edge (form A) or 105 and 210 mm from the top edge (form B).

- **United Kingdom:** BS 4264 specifies that the transparent window on a DL envelope should be 93 × 39 mm large. Its top-left corner should be located 20 mm from the left margin and 53 mm from the top margin of the envelope. BS 1808 specifies an 80 × 30 mm large address panel on the letterhead. Its top-left corner is located 20 mm from the left margin and 51 mm from the top margin of the page. The address panel is embedded inside a 91 × 48 mm large exclusion zone whose top left corner is located 20 mm from the left margin and 42 mm from the top margin of the page. In other words, the area 9 mm above and below and 11 mm right of the address panel should be kept clean of any other printing.
- **Switzerland:** The envelope window is 100 × 45 mm large and located 12 mm either from the left or the right edge. The distance to the top edge is 48 mm (for C6 and C5/C6) or 52 mm (for C5). The SNV 010130 letterhead format places the recipient's address into a 90 × 40 mm large field 45 mm from the top and 8 mm from the right edge of the A4 page. [from: H.R. Bosshard, 1980, ISBN 3-85584-010-5]
- **Finland:** SFS 2488:1994 specifies that for E series envelopes the size of the window is 90 × 30 mm and for the C series 95 × 35 mm. In either case, the left margin is 18 mm and the top margin 40 mm. SFS 2487:2000 ("Layout of document text area") and SFS 2486:1999 ("Forms Layout") specify that the area for the recipient's address is 76.2 × 25.4 mm, located 20 mm from the left, and 10±1 mm plus 25.4 mm from the top (the 25.4 mm are for the sender's information).

According to ISO 11180 and Universal Postal Union standards, an international postal address should be not longer than 6 lines with up to 30 characters each. This requires a maximum area of 76.2 × 38.1 mm with the commonly used typewriter character width of 2.54 mm (1/10") and a baseline distance of 6.35 mm (1/4").

The Universal Postal Union Letter Post Regulations specify a standard position of the address on the envelope, which is within 140 mm from the right edge, at least 40 mm from the top edge, and is surrounded by at least 15 mm unprinted envelope to the left, right and below of the address text.

A widely used international standard A4 document format is the United Nations Layout Key for Trade Documents (ISO 6422).

Folding larger pages to A4 for filing

DIN 824 describes a method of folding A0, A1, etc. pages to A4 format for filing. This clever technique ensures that there remains a 20 mm single-layer margin for filing holes, that the page can be unfolded and folded again without being removed from the

file, and that the label field at the bottom-left corner of technical drawings ends up in correct orientation on top of the folded page in the file.

Folder and file sizes

ISO 623 specifies the sizes of folders and files intended to receive either A4 sheets or simple folders (without back) that are not designed for any particular filing system or cabinet. The sizes specified are those of the overall rectangular surface when the folders or files are folded, exclusive any margin or tabs. Simple folders without back or mechanism are 220 × 315 mm large. Folders and files with a very small back (less than 25 mm) with or without mechanism are 240 × 320 mm large. Files with wide back (exceeding 25 mm) are 250 × 320 mm (without a mechanism) or 290 × 320 mm if they include a mechanism. All these are maximum dimensions. Standardizing folder and file sizes helps to optimize shelf designs and provides a uniform look and handling even if folders from various manufacturers are used.

Filing holes

ISO 838 specifies that, for filing purposes, two holes of 6±0.5 mm diameter can be punched into the sheets. The centers of the two holes are 80±0.5 mm apart and have a distance of 12±1 mm to the nearest edge of the sheet. The holes are located symmetrically in relation to the axis of the sheet or document. Any format that is at least as large as A7 can be filed using this system.

Not specified in ISO 838, but also widely used, is an upwards compatible 4-hole system. Its two middle holes correspond to ISO 838, plus there are two additional holes located 80 mm above and below these to provide for more stability. This way, sheets with four punched holes can also be filed in ISO 838 2-hole binders. This system is also known under the nickname "888", presumably because the three gaps between the holes are all 8 cm wide. Some hole punches have on their paper guide not only markings for "A4", "A5", and "A6", but also for "888". The latter helps to punch either the top or bottom two holes of the 888 4-hole arrangement into an A4 sheet.

Technical drawing pen sizes

Technical drawing pens follow the same size-ratio principle. The standard sizes differ by a factor sqrt(2): 2.00 mm, 1.40 mm, 1.00 mm, 0.70 mm, 0.50 mm, 0.35 mm, 0.25 mm, 0.18 mm, 0.13 mm. So after drawing with a 0.35 mm pen on A3 paper and reducing it to A4, you can continue with the 0.25 mm pen. (ISO 9175-1)

Ruled writing paper

There seems to be no international standard yet for ruled writing paper. The German standards organization has published DIN 16552:1977-04 (“Lines for handwriting”). That system is widely used, at least in Germany, by primary school teachers to specify which school exercise books pupils should use at which stage of learning how to write. Writing paper with fine gray 5 mm grid lines seems to be very popular in many countries.

Untrimmed paper formats

All A and B series formats described so far are trimmed paper end sizes, i.e. these are the dimensions of the paper delivered to the user or reader. Other ISO standards define the format series RA and SRA for untrimmed raw paper, where SRA stands for “supplementary raw format A” (“sekundäres Rohformat A”). These formats are only slightly larger than the corresponding A series formats. Sheets in these formats will be cut to the end format after binding. The ISO RA0 format has an area of 1.05 m² and the ISO SRA0 format has an area of 1.15 m². These formats also follow the sqrt(2)-ratio

and half-area rule, but the dimensions of the start format have been rounded to the full centimeter. The common untrimmed paper formats that printers order from the paper manufacturers are

RA Series Formats		SRA Series Formats	
RA0	860 × 1220	SRA0	900 × 1280
RA1	610 × 860	SRA1	640 × 900
RA2	430 × 610	SRA2	450 × 640
RA3	305 × 430	SRA3	320 × 450
RA4	215 × 305	SRA4	225 × 320

The RA and SRA dimensions are also used as roll widths in rotating printing presses.

Overhead projectors

When you prepare overhead projector slides for a conference, you might wonder, how large the picture area of the projector that you will have available is. ISO 7943-1 specifies two standard sizes of overhead projector picture areas: Type A is 250 × 250 mm (corners rounded with a radius less than 60 mm) and Type B is 285 × 285 mm (corners rounded with a radius less than 40 mm or cut off diagonally no more than 40 mm). Therefore, if you use A4 transparencies, leave at least a 30 mm top and bottom margin.

Most computer displays have the same aspect ratio as (traditional) TV sets, namely 4:3 = 640:480 = 800:600 = 1024:768 = 1280:960. If you prepare presentation slides, I recommend that you arrange your layout inside a 280 × 210 mm field and make sure that you leave at least 20 mm margin on the left and right side. This way, you plan for the aspect ratio of a TV/VGA projector and ensure at the same time that you can print on A4 transparencies such that every standard overhead projector will show all parts of your slides.

Identification cards

ISO 7810 specifies three formats for identification cards:

- ID-1 = 85.60 × 53.98 mm (= 3.370 × 2.125 in)
- ID-2 = 105 × 74 mm (= A7)
- ID-3 = 125 × 88 mm (= B7)

ID-1 is the common format for banking cards (0.76 mm thick) and is also widely used for business cards and driver's licences. Some people prefer A8 (74 × 52 mm) for business cards. The standard passport format is B7 (= ID-3), the German ID card has A7 (= ID-2) format and the European Union driver's licence is an ID-1 card.

History of the ISO paper formats

One of the oldest written records regarding the sqrt(2) aspect ratio for paper sizes is a letter that the physics professor Georg Christoph Lichtenberg (University of Göttingen, Germany, 1742-1799) wrote 1786-10-25 to Johann Beckmann. In it, Lichtenberg explains the practical and aesthetic advantages of the sqrt(2) aspect ratio, and of his discovery that paper with that aspect ratio was commonly available at the time. (There are also suggestions that the task to find a paper format that is similar to itself after being cut in half appeared as a question in mathematics exams as early as 1755.)

After introducing the meter measurement, the French government published

1798-11-03 the "Loi sur le timbre" (no. 2136), a law on the taxation of paper that defined several formats that already correspond exactly to the modern ISO paper sizes: "Grand registre" = ISO A2, "grand papier" = ISO B3, "moyen papier" = ISO A3, "petit papier" = ISO B4, "demi feuille" = ISO B5, "effets de commerce" = ISO 1/2 B5.

The French format series never became widely known and was quickly forgotten again. The A, B, and C series paper formats, which are based on the exact same design principles, were completely independently reinvented over a hundred years after the "Loi sur le timbre" in Germany by Dr. Walter Porstmann. They were adopted as the German standard DIN 476 in 1922 as a replacement for the vast variety of other paper formats that had been used before, in order to make paper stocking and document reproduction cheaper and more efficient. (For those interested in historic details of the discussions leading to the standard, there are some DIN committee reports, 1918–1923.)

Porstmann's DIN paper-format concept was convincing, and soon introduced as a national standard in many other countries, for example, Belgium (1924), Netherlands (1925), Norway (1926), Switzerland (1929), Sweden (1930), Soviet Union (1934), Hungary (1938), Italy (1939), Uruguay (1942), Argentina (1943), Brazil (1943), Spain (1947), Austria (1948), Romania (1949), Japan (1951), Denmark (1953), Czechoslovakia (1953), Israel (1954), Portugal (1954), Yugoslavia (1956), India (1957), Poland (1957), United Kingdom (1959), Venezuela (1962), New Zealand (1963), Iceland (1964), Mexico (1965), South Africa (1966), France (1967), Peru (1967), Turkey (1967), Chile (1968), Greece (1970), Simbabwe (1970), Singapur (1970), Bangladesh (1972), Thailand (1973), Barbados (1973), Australia (1974), Ecuador (1974), Columbia (1975) and Kuwait (1975). It finally became both an international standard (ISO 216) as well as the official United Nations document format in 1975 and it is today used in almost all countries on this planet, with the exception of North America. In 1977, a large German car manufacturer performed a study of the paper formats found in their incoming mail and concluded that out of 148 examined countries, 88 already used the A series formats then. [Source: Helbig/Hennig 1988]

Note: The Lichtenberg Ratio – used by the standard paper format series – is occasionally confused with the Golden Ratio (which Euclid referred to as the "extreme and mean ratio"). The Lichtenberg Ratio is defined by the equation a/b = 2b/a = sqrt(2), whereas the Golden Ratio is defined by a/b = (a+b)/a = b/(a−b) = (1 + sqrt(5))/2. While aesthetically pleasing properties have been attributed to both, the Lichtenberg Ratio has the advantage of preserving the aspect ratio when cutting a page into two. The Golden Ratio, on the other hand, preserves the aspect ratio when cutting a maximal square from the paper, a property that seems not particularly useful for office applications. The Golden Ratio was for a while a more fashionable topic in the antique and renaissance arts literature and it has a close connection to the Fibonacci sequence in mathematics.

Hints for North American paper users

The United States, Canada, and in part Mexico, are today the only industrialized nations in which the ISO standard paper sizes are not yet widely used. In U.S. office applications, the paper formats "Letter" (216 × 279 mm), "Legal" (216 × 356 mm), "Executive" (190 × 254 mm), and "Ledger/Tabloid" (279 × 432 mm) are widely used today. There exists also an American National Standard ANSI/ASME Y14.1 for technical drawing paper sizes A (216 × 279 mm), B (279 × 432 mm), C (432 × 559 mm), D (559 × 864 mm), E (864 × 1118 mm), and there are many other unsystematic formats for various applications in use. The "Letter", "Legal", "Tabloid", and other formats (although not these names) are defined in the American National Standard ANSI X3.151-1987.

While all ISO paper formats have consistently the same aspect ratio of sqrt(2) = 1.414, the U.S. format series has two different alternating aspect ratios 17/11 = 1.545 and 22/17 = 1.294. Therefore, you cannot reduce or magnify from one U.S. format to the next higher or lower without leaving an empty margin, which is rather inconvenient.

American National Standard ANSI/ASME Y14.1m-1995 specifies how to use the ISO A0–A4 formats for technical drawings in the U.S. Technical drawings usually have a fixed drawing scale (e.g., 1:100 means that one meter is drawn as one centimeter), therefore it is not easily possible to resize technical drawings between U.S. and standard paper formats. As a result, internationally operating U.S. corporations increasingly find it more convenient to abandon the old ANSI Y14.1 formats and prepare technical drawings for ISO paper sizes, like the rest of the world does.

The historic origins of the 216 × 279 mm U.S. Letter format, and in particular its rationale, seem rather obscure. The earliest documented attempts to standardize U.S. paper format used a completely different format. On 1921-03-28, the U.S. Secretary of Commerce (Hoover) declared a 203 × 267 mm format to be the standard for his department, which was adopted on 1921-09-14 by the Permanent Conference on Printing (established by General Dawes, first director of the Bureau of the Budget) as the general U.S. government letterhead standard. Independent of that, on 1921-08-30 a Committee on the Simplification of Paper Sizes consisting of printing industry representatives was appointed to work with the Bureau of Standards. It recommended standard basic sizes of 432 × 559 mm (17 × 22 in), 432 × 711 mm (17 × 28 in), 483 × 610 mm (19 × 24 in), 559 × 864 mm (22 × 34 in), 711 × 864 mm (28 × 34 in), and 610 × 914 mm (24 × 36 in). What became later known as the U.S. Letter format is just the first of these basic sizes halved. One hypothesis for the origin of this format series is that it was derived from a then typical mold size used then in the production of hand-made paper. “It does not appear, even in the selection of 8 1/2 × 11 inch size paper, that any special analysis was made to prove that this provided an optimum size for a commercial letterhead” [Dunn, 1972.]. It appears that this standard was just a commercial compromise at the time to reduce inventory requirements without requiring significant changes to existing production equipment. The Hoover standard remained in force until the government declared in 1980-01 the 216 × 279 mm format to be the new official paper format for U.S. government offices.

The Canadian standard CAN 2-9.60M “Paper Sizes for Correspondence” defines the six formats P1 (560 × 860 mm), P2 (430 × 560 mm), P3 (280 × 430 mm), P4 (215 × 280 mm), P5 (140 × 215 mm), and P6 (107 × 140 mm). These are just the U.S. sizes rounded to the nearest half centimeter (P4 ~ U.S. Letter, P3 ~ U.S. Ledger). This Canadian standard was introduced in 1976, even though the Ontario Government already had introduced the ISO A series formats before in 1972. Even though these Canadian paper sizes look somewhat like a pseudo-metric standard, they still suffer from the two major inconveniences of the U.S. formats, namely they have no common height/width ratio and they differ significantly from what the rest of the world uses.

Note: It was proposed for an early draft of ISO 216 to recommended the special size 210 × 280 mm (a format sometimes called PA4) as an interim measure for countries that use 215 × 280 mm paper and have not yet adopted the ISO A series. Some magazines and other print products that have to be printed economically on both A4 and U.S. Letter presses use the PA4 format today. Incidentally, this PA4 format has a width/height ratio of 3:4, the same as traditional TV screens and most computer monitors and video modes.

Both the “Letter” and “Legal” format could easily be replaced by A4, “Executive” (if it is really needed) by B5, and “Ledger/Tabloid” by A3. Similarly, the A–E formats can be replaced by A4–A0. It can be hoped and expected that with the continuing introduction of the metric system in the United States, the ISO paper formats will eventually replace non-standard paper formats also in North America. Conversion to A4 as the common business letter and document format in North America would not be too difficult, as practically all modern software, copying machines, and laser printers sold today in the U.S. already support A4 paper as a standard feature.

Users of photocopiers outside the U.S. and Canada usually take it for granted that the

machine is able to enlarge A4 → A3 or reduce A3 → A4, the two paper formats usually kept in machines with two paper trays. When they use a copier in North America, it often comes as a disappointing surprise when they find out that magnifying an entire page is not a function available there. The absence of this useful capability is a direct result of the unfortunate design of the U.S. paper formats. North American copiers usually also have two or more paper trays, but these are mostly used for the two very similar "Letter" and "Legal" formats, wasting the opportunity of offering a highly useful magnifying capability. Any enlarging of a "Letter" page onto "Legal" paper will always chop off margins and is therefore of little use. The Legal format itself is quite rarely used, the notion that it is for "legal" work is a popular myth; the vast majority of U.S. legal documents are actually using the "Letter" format. Some copiers also offer in addition or instead the next larger "Ledger" format, but that again has a different aspect ratio and will therefore change the margins of a document during magnification or reduction.

Based on the experience from the introduction of ISO paper formats in other industrialized countries at various points during the 20th century, it becomes clear that this process needs to be initiated by a political decision to move all government operation to the new paper format system. History shows that the commercial world then gradually and smoothly adopts the new government standard for office paper within about 10–15 years. It would not be a major operation to do this in the U.S. and Canada as well, especially considering that most standard software and office machines are already prepared for A4. However, such a project can succeed only if the national executive has the political will to accomplish this. The transition period of about a decade is necessary to avoid expensive equipment replacement costs for printers, especially those with older large rotary presses that were not yet designed to be easily retooled for ISO paper sizes.

If you purchase new office or printing equipment in North America, it might be wise to pay attention whether the equipment is suitable for use with A4 paper. When you make inquiries, best indicate to vendors that ISO 216 compatibility of equipment is of concern to you.

If you live in the U.S. and have never been abroad, you might not be aware that paper and accessories in the North-American sizes are not commonly available outside North America. They are very difficult to obtain in most other countries and the only practical way to get U.S. "Letter" there is to cut one of the next larger available sizes (usually B4, A3 or RA4). Therefore, do not expect anyone to send you documents in "Letter" format from abroad. If you send documents to any other country, your use of A4 will greatly ease the handling and filing of your documents for the recipient. If you design software that might be used globally, please keep in mind that the vast majority of laser printer users will print onto A4 paper. Therefore, always make A4 the default setting and the first selection choice in your printing user interface. Remember that it is the paper format used by about 95% of the people on this planet.

Due to popular demand, I have prepared an unofficial table with the ISO sizes in inch fractions. Each listed inch fraction has the smallest denominator that keeps the value within the ISO 216 tolerance limits. Product designers should use the official millimeter values instead. There is also a table in PostScript points.

A Series Formats		B Series Formats		C Series Formats	
4A0	66 1/4 × 93 5/8	–	–	–	–
2A0	46 3/4 × 66 1/4	–	–	–	–
A0	33 × 46 3/4	B0	39 3/8 × 55 3/4	C0	36 × 51

A1	23 3/8 × 33	B1	27 3/4 × 39 3/8	C1	25 1/2 × 36
A2	16 1/2 × 23 3/8	B2	19 3/4 × 27 3/4	C2	18 × 25 1/2
A3	11 3/4 × 16 1/2	B3	13 7/8 × 19 3/4	C3	12 3/4 × 18
A4	**8 1/4 × 11 3/4**	B4	9 7/8 × 13 7/8	C4	9 × 12 3/4
A5	5 7/8 × 8 1/4	B5	7 × 9 7/8	C5	6 3/8 × 9
A6	4 1/8 × 5 7/8	B6	4 7/8 × 7	C6	4 1/2 × 6 3/8
A7	2 7/8 × 4 1/8	B7	3 1/2 × 4 7/8	C7	3 3/16 × 4 1/2
A8	2 × 2 7/8	B8	2 1/2 × 3 1/2	C8	2 1/4 × 3 3/16
A9	1 1/2 × 2	B9	1 3/4 × 2 1/2	C9	1 5/8 × 2 1/4
A10	1 × 1 1/2	B10	1 1/4 × 1 3/4	C10	1 1/8 × 1 5/8

The dominance of the "Letter" format instead of ISO A4 as the common laser-printer paper format in North America causes a **lot** of problems in daily international document exchange with the USA and Canada. ISO A4 is 6 mm less wide but 18 mm higher than the U.S. "Letter" format. Word processing documents with an A4 layout can often not be printed without loss of information on "Letter" paper or require you to reformat the text, which will change the page numbering. "Letter" format documents printed outside North America either show too much white space on the top or bottom of the page or the printer refuses to operate as "Letter" format paper has been selected by the software but is not available. A4 size documents have to be copied or printed with a 94% magnification factor to fit on the 6% less tall "Letter" paper, and "Letter" documents have to be printed with 97% size to fit on the 3% less wide A4 format.

Universities in the U.S. increasingly use A4 size paper in laser printers and library copying machines, because most conferences outside North America require papers to be submitted in A4 format and many journals and conference proceedings are printed in A4 format.

The three-hole 108-mm filing system widely used in the U.S. is not compatible with the two-hole 80-mm ISO system used in most other countries. The three-hole system could of course also be used on A4 pages, but many files with a three-hole mechanism are only designed for U.S. "Letter" sheets and are not tall enough to reliably protect A4 pages. Another disadvantage of the three-hole system is that it is not suitable for storing formats smaller than U.S. "Letter".

The U.S. Postal Service standard-size range for first-class or single piece third-class mail weighing up to 28 g includes ISO C6 and DL envelopes. The U.S. currently use quite a large number of envelope formats.

The U.S. paper industry has managed to come up with a truly bizarre way of specifying the density of paper. Instead of providing you with the obvious quotient of mass per area (e.g., in grams per square meter, ounces per square yard, whatever), they specify the total mass M of a ream of N pages of some size $X \times Y$. This means, you have to know four (!) values in order to understand how to calculate the (scalar) paper density $M/(N \times X \times Y)$. The problem is that $N \times X \times Y$ depend on the type of paper, but are rarely stated explicitly.

Example: "20 lb paper" can mean that a reference ream of 500 pages in format 24×36 in has a total mass of 20 pounds. The particular reference ream size of 24 in × 36 in × 500 pages = 278.70912 m²/ream is often used in news-print applications. With 453.59237 g/lb and 278.70912 m²/ream, we get a conversion factor of about 1 lb/ream = 1.63 g/m². But that factor applies only for the news-print reference ream size

24×36 in, which is by no means universal!

Example: If you look instead at U.S. "Letter" office paper, "20 lb paper" means something very different. Here, the reference ream size is usually 17 in × 22 in × 500 pages = 120.6449 m²/ream, which corresponds to four actual reams. And so the conversion factor becomes 1 lb/ream = 3.7597 g/m², meaning that for example 20 lb/ream = 75.19 g/m² and 24 lb/ream = 90.23 g/m².

It is a big pain if you have to do these conversions yourself and you really should complain to paper suppliers who still do not manage to communicate simple g/m² values (commonly called "grammage" in both English and French) for their products.

Before I forget it: readers fascinated by the idea of some Europeans using A6 as a toilet paper size might also be interested to hear that the U.S. have for the same application field a standard square format of 4.5×4.5 in = 114×114 mm, which is for instance documented in New Jersey Specification No. 7572-01 (May 1997), section 2.3.

Below follow some links to various other on-line locations that will help you to enter the ISO paper format world.

- The Guide to International Paper Sizes by EDS Inc. describes ISO, JIS, and non-metric paper formats
- Brian Forté: A4 vs US Letter and Paper sizes for screenplay presentation
- Making Postscript and Acrobat Files International by Jacob Palme explains the problems caused by the difference between U.S. Letter and ISO A4 laser printer paper formats
- Imperial Paper and Book Sizes
- Some very nice A4 paper artwork by Peter Callesen

Although it is still rarely advertised, ISO A4 laser printer and copying paper, as well as suitable files and folders, *are* available today from many U.S. office supply companies. A4 paper and supplies have been regularly ordered in the U.S. for many years, especially by companies and organizations with a lot of international correspondence, including patent lawyers, diplomats, universities, and some government agencies.

Many of the larger stationery chains do offer at least one type of A4 paper in their catalogues. Often the only type of A4 paper available is a higher-quality brand: the type of paper one might prefer for important documents, such as international patent applications.

The U.S.-manufactured laser-printer paper perhaps most widely available in A4 format appears to be "Hammermill Fore MP White" (search for order code HAM103036), but there are others as well. If the shop assistant is unfamiliar with "A4 paper", try asking for "210 mm × 297 mm", "8 1/4 in × 11 3/4 in", "international size", or "European size" paper.

When I first wrote this page in 1996 while I lived in the U.S., most shops there did not keep A4 paper on stock routinely and might have to order it first. Many were only able to order entire boxes of 10 reams (5000 sheets) and many shop assistants were unfamiliar with the ISO paper-size system. I am being told that the situation has improved quite a bit during the last decade and that A4 paper and accessories are now a lot easier to obtain, but are still considered specialty items.

If you still cannot find any supply for A4 paper in your area, then try for example the following vendors in North America, who have confirmed to have A4 paper or related articles on stock for fast delivery:

- Empire Imports Inc., European Office Supplies, P.O. Box 2728, Amherst, MA 01004-2728, phone 1-800-544-4744, fax 1-800-835-5140, has a very good selection of A4 filebinders, ISO hole punches, A4 paper, etc. Try their A4 starter kit.
- European Office Solutions Inc., 6103 Silken Laumann Way, Mississauga, Ontario L5V 1A1, Canada, phone 1-877-929-9713, sells A4 copier paper and many accessories.
- Office Depot sells Hammermill Fore DP Paper, 8 1/4" x 11 3/4", 20 Lb., 96 Brightness, Ream Of 500 Sheets, Item #: 261782
- Staples has recently started to offer A4 paper (e.g., "HammerMill Fore MP Premium Multi-Function Paper A4-Size", item no. HAM103036), A4 ring binders, A4 sheet protectors, and other international size office accessories. (You can select "Paper size 8.27" x 11.69"" on the U.S. web site to find A4 products.)
- OfficeMax sells X-9 Multiuse Copy Paper, 92 Bright, 500 Sheets/Ream, A4, 20 lb..
- Xpedx operate a chain of paper stores in the U.S. (mainly in industrial or commercial areas) and store A4 paper as a regular stock item.
- IKEA has been reported to sell in its U.S. stores not only filing cabinets that are designed for both A4 and U.S. "Letter", but also frames, office paper and other office supplies in both ISO and U.S. format.
- Hammermill Fore MP White Office Paper, 20-lb.Sub., 210mm x 297mm, Internat'l A4
- Xerox, sells A4 paper (e.g., "Premium Multipurpose 4024, A4" or "Business 4200, A4", order no. 3R2594) for laser printers and copying machines.
- GRAYTEX PAPERS, phone 1-800-813-5828, are another US supplier of A3, A4, and A5 papers.
- more on-line paper vendors can easily be found via the Yahoo! Internet directory.

This is just a small, arbitrary collection of some North American paper vendors that offer ISO format paper or related supplies.

References

This text summarizes and explains the content of the following international standards:

- ISO 216:1975, Writing paper and certain classes of printed matter — Trimmed sizes — A and B series.
- ISO 269:1985, Correspondence envelopes — Designation and sizes.
- ISO 623:1974, Paper and board — Folders and files — Sizes.
- ISO 838:1974, Paper — Holes for general filing purposes — Specifications.
- ISO 7943-1:1987, Overhead Projectors — Projection stages — Dimensions

The following standards contain related information but are not covered here completely:

- ISO 217:1995, Paper — Untrimmed sizes — Designation and tolerances for primary and supplementary ranges, and indication of machine direction.
- ISO 328:1974, Picture postcards and lettercards — Size.
- ISO 353:1975, Processed writing paper and certain classes of printed matter — Method of expression of dimensions.
- ISO 416:1974, Picture postcards — Area reserved for the address.

- ISO 478:1974, Paper — Untrimmed stock sizes for the ISO-A Series — ISO primary range.
- ISO 479:1975, Paper — Untrimmed sizes — Designation and tolerances.
- ISO 593:1974, Paper — Untrimmed stock sizes for the ISO-A Series — ISO supplementary range.
- ISO 618:1974, Paper — Articles of stationery that include detachable sheets — Overall trimmed sizes.

These standards are available from

> International Organization for Standardization
> Case postale 56
> 1, rue de Varembé
> CH-1211 Genève 20
> Switzerland
>
> phone: +41 22 749 01 11
> fax: +41 22 733 34 30
> web: www.iso.org

The most comprehensive source of information about the ISO and North American paper formats and many related standards, as well as their respective histories, is the book

- Max Helbig, Winfried Hennig: DIN-Format A4 – Ein Erfolgssystem in Gefahr. Beuth-Kommentare, Deutsches Institut für Normung, Beuth Verlag, 1988, 144 pages, ISBN 3-410-11878-0, ~17 EUR.

DIN also produced a brief German prospectus with information about the history of the DIN paper sizes:

- Die Geschichte der Papierformate

Here are a few more references for those interested in the introduction of ISO paper sizes in North America:

- Arthur D. Dunn: Notes on the standardization of paper sizes. Ottawa, Canada, 54 pages, 1972. (out of print, available via inter-library loan from National Library of Canada, TS 1118 S5 D4, AMICUS No. 73886)
- Response from Michael F. DiMario, U.S. Public Printer, on my request for information about the introduction of ISO 216 paper formats in U.S. government agencies.
- Ad Hoc Committee Report – Metric Usage in Federal Printing, a study done in 1992 by the U.S. government that shows that migration to international standard paper formats is feasible and, with few exceptions, would not cause significant costs.

Some related media coverage:

- The logic behind metric paper sizes. Slashdot, 2004-05-14.

If you have any questions or suggestions about how this text might be improved, please contact me by email, but please do not send me any requests to add links to your own web pages. I wish to thank for helpful suggestions Gary Brown, Gene Fornario, Don Hillger, Arild Jensen, Joseph B. Reid, Bruce Naylor, Ryan Park, Terry Simpson, Karl Kleine, Jukka Korpela, David Cantrell, Oliver Baptiste, Mark Weyer, Benoit Rittaud, Frank

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You might also be interested in the Metric typographic units and International standard date and time notation web pages, or in the discussions on the USENET group *misc.metric-system*.

Markus Kuhn

created 1996-10-29 – last modified 2016-01-13 – http://www.cl.cam.ac.uk/~mgk25/iso-paper.html