Substrates for printing and packaging

Product enhancement – a glossary for print providers

Koenig & Bauer Group

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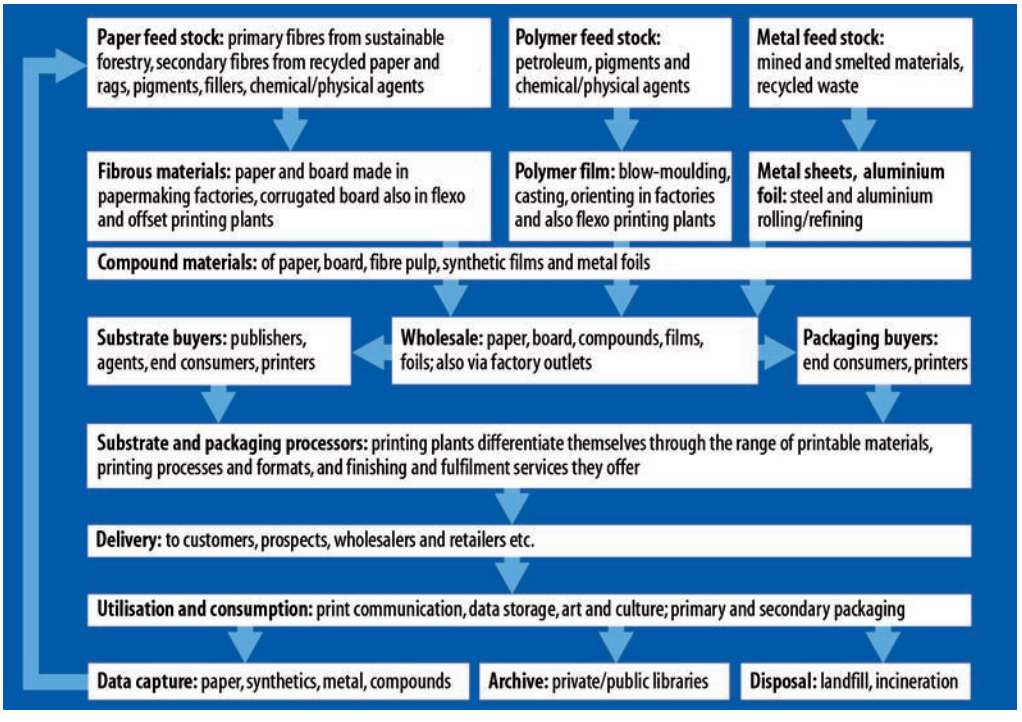
Print providers raise their profiles either by broadening the spectrum of materials they can process or by specialising in selected materials and/or formats. However, substrates are often the cause of vociferous complaints from customers. This supplement to *KBA Report* provides an overview of offset-related materials, applications, issues, trends, characteristics, properties and standards along with procedures for testing workability and printability. A list of web addresses where further information can be obtained is also provided.



In the value-added chain and the life cycle of printing and packaging substrates, printing plants function as specialised materials buyers and processors

Abrasion/rub resistance
The mechanical ability of the substrate surface to withstand abrasion.

Abrasion/rub resistance test
Used to test the ↗adhesion of ink to the substrate; the printed image is rubbed against the unprinted substrates for 48 hours (DIN 53109: abrasion wheel test, wet/dry; DIN 6723, Prüfbau abrasion test); evaluation with image analysis.

ABS, acrylonitrile-butadiene-styrene
Thermoplastic copolymer; an ABS film can be printed with UV or waterless offset inks.

Absorbency
The ability of a substrate to accept ink and fount solution through its surface and ensure ink ↗adhesion; depends on the volume of ↗sizing in the substrate; if fount solution is *ad*sorbed and remains on the surface, during wet-on-wet offset this may result in ink repulsion in the final printing units; test: volume of sizing (DIN 53126, ↗Zellcheming V/15/60), capillary rise (DIN ISO 8787, DIN 53106).

Acclimatisation, acclimation
Introducing a material into the production climate well in advance, primarily to allow moisture levels to equalise. ↗equilibrium moisture content, ↗conditioning.

Additional substrate handling packages
Options available with KBA sheetfed offset presses to enable special substrates to be printed; the packages can be customised for specific press formats and types (*table 1*).

Adhesion
The phenomenon that keeps inks and coatings on the substrate surface; indirect test: the drying speed of inks and coatings that dry by penetration and oxidation, the cross-linking speed of radiation-cured and solvent inks and coatings; no standardised tests; fast: nail test (more reliable than the sticky tape test), wipe test; testing devices for UV systems: ↗Fogra UV curing tester, SID UV tester.

Ageing
The deterioration of substrates and packaging over time, eg ↗yellowing, embrittlement. BS ISO 9706 relates to permanence, BS 6388 and ISO 5630 to the simulation of accelerated ageing.

Air conditioner
System used to create a ↗standard atmosphere in a printshop warehouse, press hall and finishing department.

Air permeability, air permeance
Property of particular relevance in packaging materials and ranging from freely permeable to hermetically sealed; resistance to the passage of air [in µm/(Pa·s)] as per Bendtsen (DIN 53120, ISO 5636-1/-3, TAPPI 460m-46).

Airmail paper
Thin, lightweight wood-free writing and envelope paper.

Alabaster paper/board
A popular choice for business cards; the surface pattern resembles alabaster.

Allowance, overcount, oversheets, plus sheets
Additional paper required to compensate for sheets inevitably spoiled during make-ready, start-up and production (↗waste).

Aluminium
A metal extracted from bauxite ore; along with ↗tin the primary packaging material used in ↗metal decorating; often used in flexible packaging as a reinforcement (on the inside) or mirrored surface (on the outside), most commonly in the form of ↗metallised paper (also used to great effect in promotional products) and ↗laminated board for drinks cartons; when exposed to air, aluminium instantly forms an oxide layer; when metallised paper is printed, the ink adheres to the aluminium oxide.

Anisotropy
The property of being directionally dependent. With reference to paper, properties influenced by the direction of the ↗grain.

Antique finish paper
White, wood-free ↗uncoated stock with a rough, minimally calendered surface.

Antistatic agents, anti-electrostatic agents
Separating or anti-friction agents occasionally incorporated in ↗polymer films to counteract electrostatic charge; however, they reduce ink ↗adhesion, so ↗static eliminators are a better choice.

APCO II/II
Art paper developed by Scheufelen for testing compliance with DIN 16519-2. Free of mechanical pulp and ↗whiteners, it is used as a reference for various standards.

Art paper
Wood-free paper coated on both sides; uniform gloss or semi-matt coating (min. 20g/m² per side) with low absorbency; outstanding printability and workability; ideal for photorealistic offset litho.

Ash content
The percentage by mass remaining when a sample of paper (100%) is ignited at 900°C (ISO 2144, ↗Zellcheming IV/40/77); the ash comprises the inorganic residue of the filler.

Banknote paper
High-grade ↗security paper incorporating ↗watermarks, metal strips and a high proportion of ↗rags for added strength; UV- and age-resistant.

Base paper
Paper manufactured specifically for ↗coating or for processing in to ↗corrugated board.

Basis weight
US term defining paper weights: the weight (in pounds) of a ream (500 sheets) of paper cut to the basic size for a particular grade of paper. The metric equivalent is ↗grammage (grams per square metre).

Beermat board, coaster board, softboard
Soft, thick and highly absorbent board; can be perfect printed in colour on an offset litho press (cheaper if ganged) or digital press.

Bending stiffness, flexural strength, rigidity
Resistance of a substrate to bending parallel or perpendicular to the ↗grain (ISO 5628; three-point beam method; TAPPI T 489 om-92: Taber test); crucial for workability and sheet travel.

Table 1: Substrate-related options available for KBA sheetfed offset presses

Option	Application	Infeed/feeder*	Printing units/coaters*	Delivery*
CX package**	Heavier, thicker board	Nonstop facility, guide rollers, capacitive double-sheet control, higher pile load capacity, lifting sucker tilting	Mechanical sheet guides with air blasts, sheet travel monitoring	Height-adjustable nonstop roller, higher pile load capacity
Microflute package**	Rigid, single-ply fine corrugated	Special sheet-guide rollers, polished cover lays	Special blankets	—
Film/plastic printing package	Non-absorbent surfaces (gloss-coated cartons, film or laminates with carton-like rigidity)	Static eliminator, roller coatings (eg chrome), hold-down shaft with rollers, rollers above cover lays, timed guide bars with rollers, air blasts	Mechanical board guides with air blasts, sheet-travel monitoring, modified grippers, static eliminator, UV conditioner (ink agitator, rollers, washing device, interdeck UV dryer, coating feed)	Guide plates with controlled airflow, convertible suction/blowing, suction roller, static eliminator, air extractor system, extended delivery with end-of-press UV dryer
Lightweight package	Paper from 0.05 mm thick	Special sheet-guide rollers	—	Suction roller
Sheeter	Cheaper web stock	Web unwinder and rotary cutter prior to feeder	—	—
Slitter	Slits large sheets in half	—	—	Rotating blade prior to delivery

** Features vary according to press type, format and customer specs. ** For thicker substrates additional options are available, eg press plinth, pile logistics.*

Bible paper
25 to 60g/m² lightweight paper with a high proportion of ↗filler and, possibly, ↗rags for greater ↗opacity (unlike many lightweight papers); commonly used for books, but also suitable for direct mail.

Blistering
More specifically, of the coating on web stock in the hot-air dryer due to the evaporation of fount solution, most probably at not less than 160° C; bonding strength can be tested using the Scott method, evaporative tendencies using a ↗Fogra Hex device.

Blocking
A phenomenon where sheets stick together in the delivery pile; can be remedied by applying powder, improving ink drying, and in UV offset by reducing the application of heat ("cold" lamps reduce pile temperature).

Bonding strength, split resistance
The internal strength of a paper, board or ↗laminate; the ability of the fibres to adhere to one another. Good bonding strength prevents fibres from coming loose (picking) when the substrate is subjected to perpendicular stress (TAPPI T 541) or shearing stress (Scott bond test: TAPPI T 403 and T 569, Brecht-Knittweis split resistance: DIN 54516).

Book(-printing) paper
Soft- or hard-sized ↗uncoated stock made from high-grade pulp and with a high mechanical resilience.

Breaking length
The amount by which a paper strip of predefined width lengthens before breaking under its own weight (DIN 53112, ISO 1924-2).

Braille printing
The production on folding cartons of tactile texts for the blind entails the use of rotary embossing tools in offset presses or die-cutting machines, or of relief coatings in screen printing. Spelling and embossing height can be checked with a ↗PTS BrailleTester.

Bristol board
A board comprising a minimum of three glued layers with wood-free calendered liners; available in different grades (index, wedding, cover, postcard; coated or uncoated).

Building material class
For the purposes of fire prevention and with respect to their storage, printing and utilisation, ↗polymer films are classified under BS EN 13501 as non-combustible (A1, A2), flame-retardant (B, C) or normally flammable (D, E2).

Bulking thickness, apparent bulk density, apparent sheet density
This is calculated by dividing the pile height by the number of sheets, and is not necessarily the same as the thickness or ↗calliper of the individual sheets (BS/EN 20534).

Bulky paper
High-volume paper made from long fibres, eg esparto grass (esparto paper).

Burst(ing) strength
Pressure (in kPa) at which a substrate ruptures; used to ascertain burst factor (burst strength divided by grammage); can be tested using the Mullen method (ISO 2758 for paper, ISO 2759 for board, BS 3137 for both), or the Schopper method (DIN 53113, expired); ISO 3689 and FEFCO 4 apply to paper and board following immersion in water.

Calender
Roller system used in papermaking to smooth the paper web and sometimes also the paper coating; production errors: ↗cockling, greying.

Calendered/glazed paper
Smooth, glossy ↗uncoated stock.

Calendering
The use of ↗calender rollers to smooth the dry or coated paper surface.

Calliper
Thickness (in µm; USA in mil = 25.4µm) of a single sheet (paper and board: DIN EN 20534, ISO 534; corrugated: FEFCO 3).

Carbonless copy paper, self-copy paper
Paper with a microcapsule coating, commonly used for business forms, 50 - 175g/m²; various types: CB (coated back), CFB (coated front and back), CF (coated front), SC (self-contained, ink applicators and receptors both on front), SC-CB (self-contained, coated back).

Cards
Rapidly growing group of printed products based on carton (carpark tickets) and ↗polymer films (customer/bank/telephone cards, tags, plant labels); can be printed economically in waterless UV offset on KBA-Metronic's OC 100/200 (direct offset in card format), KBA-Metronic's Genius 52UV or KBA's Rapida 74G UV (direct offset on thin sheet stock that can be glued in layers to create "sandwich" cards).

Carrier bag
Bag with a handle and often a base; offset-printed carrier bags made of ↗chromo paper or board are generally the preferred choice for luxury goods.

Cartonboard, paperboard
A substrate comprising one or more (couched or glued) layers of wood-pulp or wood-free material, and thicker (>0.3mm) or heavier (150 - 600g/m²) than ↗paper; surface-coated or -structured; preferred applications are as packaging (↗folding cartons, ↗laminated drinks cartons), displays, cups, paperback covers etc; the packaging material most frequently processed in offset litho.

Cast-coated paper/board
Paper or board with a white coating cast on one side. The surface can be either high-gloss (not calendered) or reflective (hot chrome-cylinder calendered); cast-coated paper has the maximum possible coating volume (over 24 g/m²); has high bulk at 70 - 400g/m² and is used for high-quality labels, covers and folding cartons.

Catalogue paper
Thin yet tear-resistant wood-pulp paper for web offset or gravure, may be coated (↗LWC, ↗ULWC) or uncoated (↗SC-A, improved ↗newsprint).

Chalk-surfaced paper
Illustration paper coated on one side and used for printing stamps and dust jackets (up to 300g/m²).

China clay, kaolin
White clay used as a filler and coating pigment.

China paper, India paper
Thin, absorbent, yellowish paper made from bleached abaca (Manila hemp), rice leaves or linters (short hairs on cotton seeds after ginning); used for artistic prints.

Chromo(lux)
Paper or board that is coated on one side and used for quality labels, folding cartons, displays, promos etc (*table 2*); differences in the coating process (blade, cast), coating volume (12 - 24g/m²), ↗bulk (1.3 to more than 1.45cm²/g) and board structure (wood-free top liner, number of intermediate and base layers containing recycled

Table 2: Gloss-coated paper and board

Coating quality and volume	Substrate type	Application
Blade-coated on one side, > 12 g/m²	Chromo duplex board, from 1.45 cm³/g (GD1)	Folding cartons/ displays
Blade-coated on one side, > 12 g/m²	Chromo duplex board, 1.3 -1.45 cm³/g (GD2)	Folding cartons/ displays
Blade-coated on one side, > 12 g/m²	Chromo duplex board, - 1.3 cm³/g (GD3)	Folding cartons/ displays
Blade-coated on one side, > 12 g/m²	Chromo triplex board (GT1, GT2, GT3)	Folding cartons/ displays
Blade-coated on one side, ca. 18 g/m²	Chromo board (GC1, GC2, GC3)	Folding cartons/displays, commercials
Blade-coated on one side, > 20 g/m²	Chromo paper	Commercials, labels
Blade-coated on one side, > 20 g/m²	Coated pulp board (GZ)	Folding cartons/ displays
Cast-coated on one side, > 24 g/m²	Cast-coated chromo board (GG1, GG2)	Folding cartons/ displays
Cast-coated on one side, > 24 g/m²	Uncalendered high-gloss paper	Commercials, labels
Cast-coated on one side, > 24 g/m²	Cast-coated pulp board (GGZ)	Folding cartons/ displays
Roller-coated on both sides, 5 - 20 g/m²	Illustration printing paper	Commercials, picture books
Roller-coated on both sides, 5 - 20 g/m²	Art paper	Commercials, picture books

fibres); the range includes coated paper and board (GC), duplex board (GD) and triplex board (GT); an alternative is uncoated imitation chromo board (UC) covered with wood-free liners on one or both sides.

Clouds, mottling

1. Non-uniform paper surface and structure (↗formation), eg poor sizing. 2. mottling in full or screen solids in offset litho can have various causes: a) see 1; b) ink resplitting on coated paper; c) inadequate ↗water absorption by coated paper in the first printing unit; d) incorrect roller setting or printing pressure.

Coated paper/board

Paper or board, finished on one (↗chromo) or both sides (↗illustration paper and ↗art paper) with a surface application (5 - 25 g/m²) of white ↗coating slip; distinguished according to gloss (matt, semi-matt, gloss or high gloss, with or without subsequent glazing), workflow (coated inside or outside the papermaking machine), ↗coating process and number of coats (single, double, triple).

Coating

The inline or offline application of ↗coating slip by any one of various methods: via pigmentation (up to 5g/m²), dipping (of the web in a vat) or casting (a to over 24g/m²), with a brush, air-knife (with nozzles), roller (from roller nip) or blade (from doctored dip roller or gravure cylinder); also extrusion coating (application of a separate polymer emulsion as a water and grease barrier.

Coating slip/colour/slurry

Aqueous solution made from calcium carbonate, pigments (chalk, kaolin), starch, casein and synthetic resins and used to coat paper and board.

Cobb test/method

Method for determining the water absorbency of paper, solid board and corrugated board (EN 20535, ISO 535, FEFCO 7); the Cobb number corresponds to the amount of water (in g) absorbed by 1m² of substrate in a prespecified time; the Cobb-Unger method performs the same function for ↗oil absorbency.

Cockling, creasing, waviness

A defect primarily seen in thick, adhesive-bound heatset products caused by disregarding the ↗grain, too high a dryer temperature, excessive or nor emoistening; in sheetfed stock caused by moisture seeping in from the edges.

Coextruded film, co-ex film

Bonded film created through the ↗extrusion of two similar or different molten polymers.

Cold (stamping) foil

Material used to inline finish prints in sheetfed offset (KBA CF for Rapida presses); the metallic pigments (for gold, silver, bronze effects) are transferred from the carrier to the substrate by the adhesive force of the print varnish; much finer detail reproduction is possible (offset quality) than with ↗hot stamping foils, but cold foils are also a more economic alternative to ↗metallised paper, with its printability issues.

Colour cast, off shade

Deviation from ↗paper white (DIN 55980: absolute; DIN 55981: relative; ISO 11475: determination of CIE whiteness).

Colour densitometry

Measurement of the optical density of a colour by shining light on it and measuring its transmission.

Colour guide/swatch/chart

An aid to colour selection; invaluable when reproducing colours on different substrates, eg newsprint, uncoated/coated/continuous stock. Examples are HKS and Pantone.

Colour tone, shade, hue, tint

Colorimetric values for tinted substrates, eg CIE L*a*b* or colour difference DeltaE* (ISO 7724, DIN 5033 or 53140, or DIN 53145 with ↗Elrepho), diffuse radiance/reflectance factor (ISO 2469; for C/2 degrees ISO 5631: diffuse reflectance method).

Coloured paper

Beater- or surface-dyed wood-pulp or wood-free paper, eg ↗sign paper; ideal for flyers.

Conditioning

Preparing a substrate for the production environment to enhance printability and workability; it can include acclimatisation (to balance the moisture content), heating or cooling (to align the temperature), an antistatic charge (to eliminate ↗static electricity), relaxation (to ensure ↗flatness) and ↗adhesive priming (preprinting).

Continuous stationery

Wood-free or wood-pulp uncoated roll paper for computer print-outs (DIN 6723-1, -2)

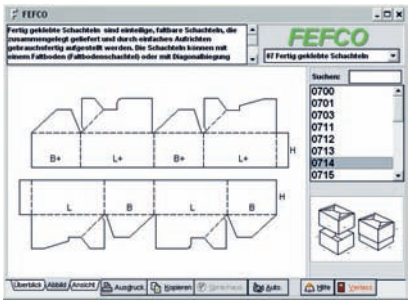
Convertibility, finishability

The ability of printed sheets and sections to be mechanically finished with no loss of quality once the ink has dried; can be accelerated by applying a quick-dry top coating.

Corona surface treatment

An electric charge applied to the surface of non-absorbent metallic foil and polymer film to increase the ↗surface tension (*table 12*) and thus improve ink ↗adhesion; even where substrates have been pretreated by the manufacturer, it may be advisable to configure the press with a corona unit (KBA recommends Ahlbrandt) because the effect diminishes over time.

Datacolor Elrepho 450X



CAD schematic of a folding carton from FEFCO's catalogue

Corrugated board

Packaging material containing secondary fibres (DIN 6735) and comprising one or more layers of paper corrugated between two knurled rollers and glued to a liner of smooth paper, the topmost one of which is usually made of kraft paper. Available as open- or single-face corrugated (with liner on just one side of the corrugated layer), or single-, double- or triple-wall corrugated (with liner on both sides of one, two or three layers of corrugated). Only single wall corrugated can be printed in direct offset, on KBA presses only extra-fine and micro-flute; the requisite properties are defined in DIN 55468.

Cracked coating

A flaw associated with incorrect folding (paper), folding without prior creasing (cartonboard) or weakened coating as a result of a chemical reaction and heat input during UV curing.

Cracked fold

The result of substrate brittleness caused by the excessive extraction of moisture in the hot-air dryers on web offset presses, and most noticeable during folding; cracks during folding occur most frequently on paper and board weighing over 170g/m² if they have not been creased beforehand: DIN 55437, ↗Fogra fold tester.

Creasability

The ability of board to be creased to form a hinge without tearing its surface coating or fibrous structure (DIN 55437-2: crease-testing device; DIN 55437-3: folding behaviour of creased samples).

Crush resistance

There are various standards for testing the crush resistance of board packaging; stacked boxes: BCT (ISO 2234, EN ISO 12048, EN 24180-1/-2, FEFCO 50, EN 22874); axially loaded strait strips of material: SCT (ISO 9895, DIN 54518), circular strips of material: RCT (DIN 53134); flat corrugated: FCT (EN ISO 7263, DIN EN 23035, FEFCO 6); corrugated base paper: CMT (DIN EN ISO 7263); corrugated board edges: ECT (DIN EN ISO 3037, FEFCO 8); top liner and corrugated paper: CCT (TAPPI T 824 om-93); crush resistance index: STFI (in kNm/kg).

CSWO, coldset wet offset

Term applied in the paper industry to web stock printed on conventional wet offset newspaper presses.

Curling, sheet curl

Caused by changes in humidity or shrinkage through polymerisation of the printed UV inks and coatings (ISO 14968: curl in a pack of sheets; DIN 6723: paper for use in optical character recognition systems.

Cutting/trimming quality

Edge quality (BS/ISO 22414), eg rounding for concave fore-edge.

De-inking, deinking

Process for removing the ink from ↗recycled paper; various chemicals are added during flotation to dissolve both water- and oil-based inks.

Density

Substrate density is defined by DIN 53105 (in g/cm³) and EN ISO 534 (in kg/m³); printing paper averages 800kg/m³; relative density is the ratio of the weight of one type of paper to another.

Diffuse reflectance/radiance factor

Optical property of substrates; it is measured in accordance with ISO 2469, DIN 53145-1/-2.

Dimensional stability

The ability of a substrate to resist changes in its dimensions under the impact of moisture (ISO 18903); following controlled immersion in water (ISO 5635) it is possible to determine the percentage change in length, width and thickness (↗swelling).

Directory paper

Thin, ↗uncoated web offset wood-pulp stock (approx. 35g/m²) used for telephone directories and address books.

Document paper

Wood-free, hard-sized, writable/printable and age-resistant paper weighing 60 to 120g/m².

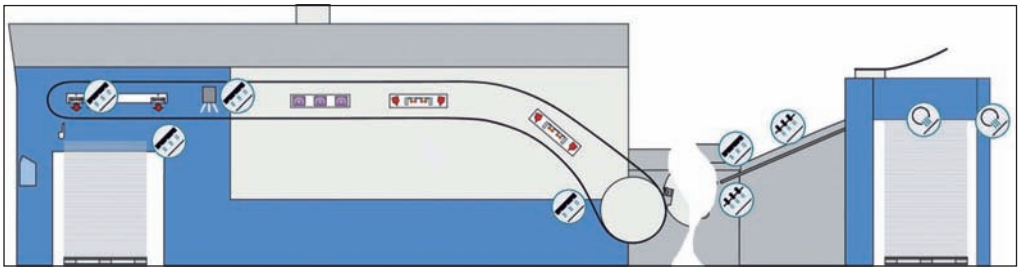
Dot gain

A typical offset phenomenon where each dot of ink spreads when printed. Influenced by various factors such as the substrate

Table 3: Corrugated board flutes

Type	Description	Flute pitch	Flute frequency	Flute height
O	Graphics flute	1.3 - 1.4 mm	714 - 769/m	0.3 mm
N	Graphics flute	1.6 - 1.8 mm	555 - 625/m	0.4 - 0.6 mm
G	Graphics flute	max. 1.8 mm	min. 555/m	max. 0.55 mm
F	Extra-fine flute	1.9 - 2.6 mm	384 - 526/m	0.6 - 0.9 mm
E*	Microflute	3.0 - 3.5 mm	283 - 333/m	1.0 - 1.8 mm
D*	Midi-flute	3.8 - 4.8 mm	208 - 263/m	1.9 - 2.1 mm
B*	Fine flute	5.5 - 6.5 mm	153 - 182/m	2.2 - 3.0 mm
C*	Medium flute	6.8 - 7.9 mm	126 - 147/m	3.1 - 3.9 mm
A*	Coarse flute	8.0 - 9.5 mm	125 - 105/m	4.0 - 4.9 mm
K	Maxi-flute	min. 10.0 mm	max. 100/m	min. 5.0 mm

** DIN 55468*



Kersten Elektrostatik static eliminators at the feeder and infeed on a KBA Rapida

Table 4: Proofing substrates as per FograCert

Quality	Gloss	CIELAB
Gloss	min. 60%	$L^* > 95; a^* = 0; b^* = 0$
Semi-matt	21 - 59%	$L^* > 95; a^* = 0; b^* = 0$
Matt	max. 20%	$L^* > 95; a^* = 0; b^* = 0$
Tolerance	—	L^* u. $a^* \pm 2; b^* +2/-4$

Gloss measurement as per ISO 8254-1/TAPPI 75

(↗ISO paper types), halftone screen (l/cm, ↗light-trapping effect), screen modulation (autotypical, FM) and ink (offset litho, heat-set, coldset, UV, waterless); the compensation curves for different combinations of factors are specified in ↗Fogra characterisation tables.

Double-coated paper
Wood-free paper with a double coating on one or both sides comprising a primer plus matt or gloss top coat; allows ultrafine screens in offset and high-quality digital prints.

Duplex and triplex paperboard
Board made from two or three layers of ↗waste paper; also the base for ↗chromo board.

Duplex paper
Paper comprising two layers with their wire sides glued together; usually layers of different ↗colour tones or reactivity (intentional ↗two-sidedness).

Dusting, powdering, whitening, linting
The detachment of poorly bonded fibres and filler particles from the surface of ↗uncoated stock and their deposit on blankets and formes.

Dynox treatment
Process developed by Klöckner (www.kpfilms.com) to improve the UV printability of hard ↗PVC film by increasing the ↗surface tension to more than 45mN/m; unlike a ↗corona surface treatment the effect is unimpaired by lengthy storage (over one year) and processing.

ECMA code
CAD catalogue (www.ecma.org) of folding-carton designs, comparable to the ↗FEFCO-ESBO codes.

Edge curl
If the ambient climate is too humid, rollers and paper will absorb moisture and curl at the edges.

Edge shrinkage
If the ambient climate is too dry, rollers and paper will shrink and become tight-edged.

Edge tearing resistance
The resistance offered by a substrate to tearing where a cut has been made parallel or perpendicular to the ↗grain; thermoplastic flexible film: ISO 11897.

Elasticity/Young's modulus, elasticity, E
Rise (in N/mm ^{2}) in the curve showing the quotient of changes in tension relative to elongation (ISO 1924); can be determined from the ↗breaking load; allows inferences to be made as to ↗dimensional stability and ↗bending stiffness.

Electrical properties
Primarily relevant for film, more specifically with reference to its volume resistivity (DIN 53482, DIN IEC 93), surface resistance (DIN 53482), relative permittivity (DIN 53483) and puncture strength (DIN 53481); ↗static electricity.

Elrepho 450X
Datacolor's (www.datacolor.ch) dual-beam spectrophotometer with measurement geometry, diffuse illumination and 0° viewing; a reference measuring device used in ISO standards 2469 (↗diffuse radiance/reflectance factor) and 2470 (↗brightness).

Embossed paper
Paper that has been given a three-dimensional surface, eg hammered, imitation linenweave, by an embossing calender roller.

Envelope paper
This can be white, unbleached or coloured, and made from wood pulp or wood-free pulp; opaque, writable and printable, relatively stiff.

Equilibrium moisture content
↗moisture content (in %) of paper or board after acclimatisation (↗Zellcheming V/30/9).

Extrusion
A process whereby a material is ejected under pressure from a nozzle or die with the desired cross-section. Used to create ↗polymer film from ↗molten polymer.

FC paper, film-coated paper, size-press coated paper
In papermaking, offset paper that has received a thin pigmented coating on both sides in an integrated size press.

FEFCO-ESBO Codes
Codes published by European associations FEFCO (www.fefco.org) and ESBO (www.esbo.nl) for folding-carton and display samples made of corrugated and solid board; CAD files available as a CD-ROM catalogue; ↗ECMA Code.

Felt side, top side
The side of a sheet or web of paper that had no contact with the forming wire; usually, but not always, the better side for printing; ↗two-sidedness.

Fibre lifting
Thermal drying can cause fibres to lift on the surface of the paper, impairing gloss.

Fibres
Threadlike cellulose structures whose ability to bond together (fibre-to-fibre bond) is exploited to make paper and board; softwood fibres are two to three times as long as hardwood fibres, bast fibres are the longest.

Fillers, loading material
Fine particles of inorganic materials such as clay, blanc fixe, talcum or titanium dioxide that settle among the ↗fibres in paper and modify properties such as ↗opacity, ↗brightness and ↗smoothness; the higher the filler content, the cheaper the paper.

Film homogeneity
The uniformity of ↗polymer films when printed, stretched or deep drawn.

Fine board
Hardboard or fibreboard (rigid, split-resistant, surface-hardened, eg with polymer emulsions) with surface finishing (calendered, coated or embossed); not usually printed, it is used as bookbinder's board.

Fine paper
Wood-free (max. 10% wood pulp) rag paper whose surface can be coated or uncoated, white or coloured, embossed, matt, calendered; 80 - 400g/m ^{2}; for high-quality prints.

Flatness
A desirable property of paper and film, both as a single sheet or in the pile; opposite: curling, buckling, edge curl, cockling.

Fogra
Forschungsgesellschaft Druck, Munich (www.fogra.org). Activities: the development of testing devices, the management of characterisation tables for ↗ISO paper types and printing processes, appraisal reports on faulty production processes (eg an online catalogue of paper and print finishing errors), standardised tests on substrates, including plastic ID cards and proofing media (↗FograCert).

FograCert
Certification by ↗Fogra of proofing media as per ISO 12647-7:2007 (*table 4*).

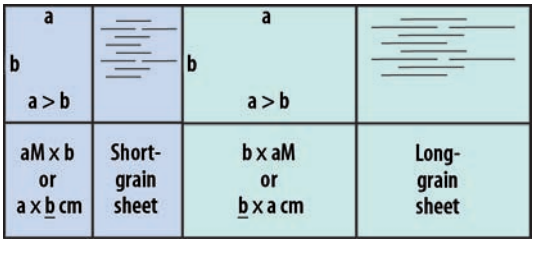
(Folding) boxboard
Single- or multilayer board made from primary or secondary fibres, sometimes with a wood-free or coated top liner that can be easily creased and scored; printed on sheetfed or narrow-web offset presses.

Folding endurance/strength
The number of times a strip of paper or board can be folded backwards and forwards under tension before it breaks; test: ISO 5626: Köhler-Molin, Lhomargy, MIT and Schopper testers, TAPPI T 423cm-07.

Formation
The alignment and structure of the fibres in a sheet of paper, visible when held against the light; a distinction is made between well-closed and cloudy or wild.

Ghosting
A faint replica of a printed image; may be due to lack of ink replenishment following an ink-intensive application. Mechanical ghosting is the appearance of a secondary, "phantom" image on the printed side of the sheet and is usually traceable to conditions on the printing press and/or layout of the forme. Chemical, or gloss, ghosting can occur when inks containing drying oils are used in production: vapours from drying ink on one side of a sheet may interact chemically with the ink printed on the reverse side or on the sheet above, creating a phantom image. Usually takes the form of a change in gloss or slight yellowing; not the same as ↗set-off or ↗show-through.

Gloss
Optical phenomenon created by directed reflection on the surface of film and coated substrates; gloss levels (in % or with no unit of measurement) are determined by measuring the intensity of the reflected light where the angle of incidence equals the angle of reflection; customary geometries: 20°/20° (for high gloss), 85°/85° (matt gloss), 60°/60° (medium gloss), 75°/75° or 45°/45° (prints, substrates and packaging materials); various standards (ISO 8254, DIN 54502, TAPPI 75°; reflectometry as per ISO 2813, ASTM D523, DIN 67530, ↗Zellcheming V 22/72).



How grain (M) may be indicated on packs of sheets

Gluability
More specifically of corrugated board, in kN/m (TAPPI T821 pm).

Grain, machine papermaking direction
The direction in which most of the ↗fibres in a piece of paper are oriented and the axis along which the paper tears and flexes most easily; determined by the direction in which the forming paper web moves on the forming wire in a papermaking machine. It can be established by moistening (tends to swell across the width), tearing or folding (neatest parallel to the papermaking direction) and flexing (easiest across). ↗long grain, ↗short grain.

Grammage
The area-related weight (in g/m²) of a substrate after controlled ↗conditioning, ie with a ↗moisture content as per EN ISO 536, ISO 12625-6 (tissue paper); ISO 5638 (single layers of fibreboard); ISO 3039 (corrugated fibreboard), EN 22286; the ↗density can be calculated from the grammage and ↗thickness; ↗basis weight.

Gravure paper, rotogravure paper
Lightly sized and thus highly absorbent paper with a soft surface and large proportion of filler; there are both coated (↗LWC, ↗ULWC) and uncoated (↗SC-A/-B) types with good ink take-up and strength at maximum web speeds.

Grease permeability
The length of time that paper and board repel grease and oil (ISO 16532-1); TAPPI UM 557 (KIT Test) also includes resistance to wax.

Grey board
Board that is rough on both sides or smooth on one side and made of ↗recycled fibres; used eg for calendar backing

Handmade paper
Paper with a regular mesh impressed upon it by the dandy roller in a papermaking machine. Produced in a similar way to a ↗watermark; used for quality business forms.

Hardboard
Solid board made of couched fibrous layers that are particularly ↗rigid; 0.9 - 3.5mm thick, suitable for embossing; cover material for office files.

Hardness
A property influencing printability, important with thick elastic film; testing process: ball indentation hardness (in MPa or N/mm², EN ISO 2039-1, DIN 53456); Shore hardness (DIN 53505, DIN EN ISO 868: Shore A for soft elastomers, Shore D for hard elastomers).

Hot (stamping) foil
Material used in print finishing; pigments (gold/silver effect, opaque inks) are transferred on a carrier to the substrate by a hot embossing tool (in tandem with die-stamping in folding carton production) along with a heat-reactive film of glue; ↗cold foil.

HSWO, heatset wet offset
Abbreviation used in the paper industry for wet offset web stock used on commercial and narrow-web presses fitted with hot-air dryers.

HTR, PHEMA, hard tissue replacement
Polyhydroxyl ethyl methacrylate; extremely tear- and UV-resistant film for flexo and offset printing; suitable for deep-drawing and laminating.

Humidity
Ambient humidity affects the ↗moisture content of paper; ↗acclimatisation, ↗equilibrium moisture content.

Hybrid printing
A technology developed and signally advanced by KBA; in sheetfed offset, printing with hybrid inks which can be dried conventionally or cured by UV radiation then UV-coated without a primer to create unusual gloss effects on gloss- or matt-coated substrates; in newspaper offset, the production of newspapers and supplements using the same ink, either a) by printing supplements using the same paper as for newspapers and with waterless cold-set inks but with a heatset dryer (KBA Cortina), whereby dot gain remains the same, or b) by printing supplements on different (improved) paper with coldset inks and no heatset dryer, but in an FM screen and with a different dot gain.

Hygroexpansion, wet expansion
Partially reversible dimensional change (in %) caused by water penetrating the bonded fibres in paper or board, eg during faulty acclimatisation or travel through the printing units (ISO 8226).

Hygroscopicity
The ability of paper to absorb moisture from the air.

Hysteresis
↗Hygroscopicity cycle associated with ↗swelling and cross-↗grain ↗hygroexpansivity, where a residual expansion or swelling remains even if the ↗moisture content drops back to the original or to a minimum; depicted graphically as a hysteresis loop.

Illustration printing paper
Perfect-coated paper for high-quality prints in sheetfed (grades: ↗ISO paper type 1, standard, consumer) and web offset (↗MWC/HWC); gloss, matt or silk-matt coating, max. 20g/m² per side; the base paper is wood-free, wood-pulp or laminated; 80 to 250g/m².

IML, in-mould labels
Labels predominantly made of drawn multilayered ↗polypropylene film, which after being printed are inserted in a mould in to which the host material (eg for deep-drawn containers/lids, drinks crates, blow-moulded bottles) is injected and cured; printable with conventional inks in sheetfed offset (trend) or photopolymer letterpress and UV inks in sheetfed and narrow-web offset, gravure, flexo and letterpress; distortion-free in-mould labels with a matt textured surface are known as soft touch labels.

Improved stock
Calendered, ↗uncoated web offset stock with defined ↗brightness.

Inert UV/gas curing technology
A method for curing UV inks in a protective nitrogen atmosphere, displacing the ambient oxygen which impedes cross-linking; as a result as much as 80% less heat is required to cure the inks, and the pile temperature is up to 50% cooler. Benefits: enables heat-sensitive ↗polymer films to be printed and allows higher production speeds; developed for narrow-web offset, it was first used on a sheetfed press – a KBA Rapida 105 at Belgian plastics printer Crea – in 2002.

Initial tearing strength
The resistance to tearing offered by a substrate when tension is applied to the edges (flap, laminating film); tensile strength as determined by Bekk.

Ink absorbency/receptivity
A substrate characteristic that determines how much ink will penetrate its surface. ↗oil absorbency.

Ink penetration time
Ink absorption by substrates can be tested statically using a test press (IGT, Prüfbau) and dynamically using an ultrasound device (emc oDPM), which measures the depth penetrated in a specific unit of time.

(Ink) trapping
In process colour printing, the action of printing one ink film on top of another, so that the ↗adhesion of the first film on the substrate ensures adhesion of subsequent films.

ISO paper types
As defined in ISO norm 12647-2, five paper types whose ↗paper white, ↗brightness and ↗gloss, but not necessarily ↗grammage (*table 5*) correspond to the average of the types most commonly used for printing; developed to calculate universally available ICC standard profiles for various parameters (dot gain, screen width, tolerances) in sheetfed, web and continuous offset printing; they support the standardised reproduction of colours in print and also their faithful simulation in digital proofs; the targeted CIELAB chromaticity coordinates of the ISO colour scales are clearly defined (with recommended full-solid densities); in practice, paper properties tend to vary enormously from those defined by the ISO, so for quality assurance purposes the classifications are too general and are therefore often superseded by much more rigorous criteria.

Table 5: The five paper types for the processes defined in ISO 12647-2, with their reference values and uses

Type	Quality	Paper white (CIELAB)	Whiteness	Gloss	Examples (irrespective of grammage) and uses
PT1	Illustration, gloss-coated, 115 g/m²	$L^* = 93; a^* = 0; b^* = -3$	85% ISO	65%	Illustration, rarely MWC, HWC (sheetfed offset, heatset, gravure)
PT2	Illustration, matt-coated, 115 g/m²	$L^* = 92; a^* = 0; b^* = -3$	83% ISO	38%	Illustration, matt, rarely MWC, HWC (sheetfed offset, continuous, heatset, gravure)
PT3	LWC web offset, lightly coated, 70 g/m²	$L^* = 87; a^* = -1; b^* = 3$	70% ISO	55%	FC, LWC, ULWC, MWC, HWC (heatset, gravure)
PT4	Offset, uncoated white, 115 g/m²	$L^* = 92; a^* = 0; b^* = -3$	85% ISO	6%	Wood-free, wood-pulp, SC-A (sheetfed offset, heatset, coldset, hybrid h/c, continuous, gravure)
PT5	Offset, uncoated yellowish, 115 g/m²	$L^* = 88; a^* = 0; b^* = 6$	85% ISO	6%	SC-A, SC-B, NP, improved NP (coldset, heatset, hybrid, gravure)
—	Tolerance	$L^* \pm 3; a^* \pm 2; b^* \pm 2$	—	± 5%	—

CIELAB values: D50/2°, no polish; white measuring underlay for profile generation, black for production print

Ivory board
Stiff board (240 - 320g/m²) super calendered with waxed rollers and with a yellowish or greyish tinge; used for greetings and business cards.

Japanese vellum, Chinese vellum
Long-fibred paper imported from Japan or China, usually handmade of bast fibres; can be exceptionally thin, absorbent, burst- and tear-resistant; in offset litho it is good for printing sophisticated, upmarket products with enhanced tactile appeal.

Kraft liner
Paper weighing 120g/m² or more and made from sulphate pulp; used as liner for corrugated board.

Kraft/sulphate paper
A particularly tear-resistant, easily printed paper made from soft wood sulphate pulp and used for sacks and carrier bags.

Label paper
Used for printing labels on sheetfed and narrow web offset, gravure and digital presses; well-sized, coated or laminated on one side, water- and alkali-resistant (but easily removed in bottle-rinsing machines and bottling plants), can be easily coated, bronzed and die-cut.

Laid paper
Machine-finished paper with parallel lines formed in a ↗watermark process to simulate the wire structure of ↗handmade paper; printed laid is used as gift-wrapping paper, unprinted as endpaper.

Laminability
The ability of a substrate to accept a full-solid application of adhesive followed by a liner (eg transparent ↗polymer film for gloss/protection, or printed paper eg on corrugated board); one criterion when selecting substrates and inks.

Laminate
Printing or packaging substrate in which identical or different layers of material are

glued or welded together with the aim of creating optimum, ↗split-resistant substrates with the printability, strength, barrier functions, colouring or gloss of the component materials; options: polymer/polymer (food storage bags), paper/polymer (eg greaseproof microwave bags), board/aluminium/polymer (drinks cartons), paper/aluminium (metallised paper), paper/paper (corrugated board), fibre pulp/paper (solid board, duplex/triplex carton).

Laminated board for drinks cartons
A composite of wood-free board (75%, with antibacterial ↗PE coating, printable on flexo and narrow-web presses), 6µm aluminium foil (5%, acts as barrier against light, heat, air and migration) and ↗polymer film (20%, sterile seal).

Lamination
The process whereby two or more layers are bonded together to form a composite, or where a layer of substrate is sealed between two layers of plastic. ↗laminated board for drinks cartons.

Lenticular film
↗PET film which is smooth on one side and has an array of lenticules on the other; the smooth side can be printed in conventional UV offset (KBA Rapida 74 to 205), waterless offset (KBA Rapida 74G, 46 and 74 Karat) or waterless UV offset (KBA-Metronic Genius 52UV, KBA Rapida 74G UV), and registration must be absolutely precise; special software is used to split the multiple images into fine strips and interleave them in the relevant order. Each image strip is then positioned beneath a lenticule, eg 12 strips for 12-phase images; the more phases there are, the higher the resolution must be and the finer the gauge of the lenticule (*table 6*); effects possible: flip-flop images, animated sequences, morphing, zoom, 3D views; fast-growing market.

Light-fastness
Here, the ability of white and coloured substrates to resist yellowing or bleaching when exposed to UV radiation; the comparative scale established using eight blue strands of wool (EN ISO 105-B02, Xenotest Alpha) ranges from 8 (high resistance) to 1 (very low resistance).

Light-trapping effect
A property of printed paper whereby diffuse light penetrating the upper layers is prevented from escaping because it is absorbed by the layers of ink.

Lightweight paper
Thin paper weighing 40g/m² or less and with low ↗opacity; commonly used for high-pagination books; KBA offers remotely adjustable suction rings for optimum sheet travel.

Lignin
Component of wood which is removed during the pulping process in order to enhance ↗whiteness and prevent ↗yellowing.

LLWC
↗ULWC

Loan paper
High-grade wood-free, writable paper (often rag paper) used for certain security documents such as loans and bonds.

Long grain, MD, machine direction
Where the paper ↗grain runs parallel to the longer side; opposite: ↗short grain.

Low-grade paper
Base stock for various types of ↗corrugated board, made from unsorted waste paper.

LWC paper, lightweight coated paper
Lightweight (approx. 50 - 70g/m²) paper thinly coated on both sides and used for long print runs in web offset and gravure; for high-quality magazines, newspaper supplements and catalogues.

Machine coated paper, MC paper
Paper that has been coated on both sides in the papermaking machine.

Machine-finished/-glazed paper, unglazed paper, MF/UG paper
Machine-smooth, ie rough, uncalendered, ↗uncoated stock for low-quality printed products.

Machine-glazed paper/board
Paper or board with a high-gloss finish produced by allowing the wet web to dry against a highly-polished metal cylinder, also called a yankee dryer.

Magazine paper
Web stock, usually ↗LWC, ↗MWC or ↗SC.

Map/chart paper
A ↗dimensionally stable, moisture-resistant or moisture-proof paper used to print land maps and nautical charts (sheetfed speciality); good ↗folding endurance.

Marbled paper
Paper with a pattern created by adding darker fibres.

Mechanical paper, wood-pulp paper
Paper that contains more than 5% mechanical wood pulp; there is currently a strong demand for medium-fine litho paper along with improved ↗newsprint and ↗SC-A.

Metal decorating
Specialist offset application for converting metal sheets between 0.12 and 0.5mm thick into ↗metal packaging; KBA-MetalPrint, the market leader, offers a complete range of systems that can handle both UV inks and coatings and conventional ones that are baked in inline ovens; one to eight colours; Metalstar 2 (1,000 x 1,200mm), Sprint (1,000 x 1,220mm), Mailänder 120A (970 x 1,145mm) and Metalwing 2 (modified KBA Rapida, 965 x 1,200 or 1,000 x 1,400mm); offline (Sprint, Mailänder) or inline (Flexocoat) coating systems, sheet and plate handling, exhaust air filtration.

Metal packaging
Drums, jugs, canisters and hobbocks made of steel plate (>0.5mm thick) for industrial and consumer goods, or cans and boxes (for food and drinks, household chemicals and cosmetics), screw caps, vacuum caps, crown corks, decorations, promotional products and toys made of fine sheet metal (<0.5mm), ↗tin plate or ↗aluminium; ↗metal decorating.

Metal-laminated paper
Paper on which a silver- or gold-coloured matt, gloss or structured aluminium foil has been glued (↗laminate), usually on one side; can be printed with UV and IR inks; for labels, sweet wrappers, coffee packaging, decorations and conspicuous promotional products (primarily reflective cartons).

Metallised paper
Paper that has been coated on one side with hot aluminium vapour at over 1,000°C in a vacuum chamber to create a fine, opaque, mirrored surface; can be printed with UV inks; used for exclusive labels, wrappers and decorations.

Milking
The gradual build-up of coating or filler material from the paper on the non-image areas of the blanket. Over time this can be abrasive to the lithographic plate, and can sensitize the non-image areas of the plate resulting in ↗scumming. Milking can result from the softening of a coated paper surface by the fount solution in the first printing unit(s), and only become evident in later or the last printing unit(s). ↗dusting. Severe milking or dusting is called piling.

Millboard
Multilayered material made of wood or recycled fibres, the solid version of which (↗solid board) is thicker (>1.5mm) and/or heavier (>600g/m²) than ↗cartonboard; ↗corrugated board can be thinner and lighter.

Mirror paperboard
↗metal-laminated paper.

Moisture content
Determined by oven-drying paper or board at 105°C and comparing this with the conditioned state (EN 20287, ISO 287).

Monofilm
Polymer film composed of just one type of ↗polymer; opposite: ↗coextruded film.

Mottled paper
Paper patterned with finely distributed coloured ↗fibres; used for printing banknotes and security documents.

Mottling test
A test based on image analysis (eg Only Solutions' Mottling Viewer) for assessing ↗mottling in paper, full solids and screen solids.

MWC/HWC paper, medium-/heavyweight coated paper
Wood-pulp paper weighing 70 - 130g/m² and coated on both sides.

Newsprint, NP
↗uncoated stock entirely or partially comprising recycled fibres, available in standard and improved quality (higher degree of ↗brightness, ↗smoothness and ↗opacity); 40 - 55g/m².

Nominal weight
In the US, the weight at which paper is billed. A plus or minus tolerance relative to its basis weight is permitted unless other arrangements have been made between the mill and the customer.

Table 6: Lenticular film thickness

Resolution	140 lpi	100 lpi	75 lpi	60 lpi
Thickness	255 µm	355 µm	475 µm	508 µm
Resolution	3D 100 lpi	3D 62 lpi	3D 40 lpi	
Thickness	580 µm	687 µm	832 µm	

Source: DPLenticular.com

Notched impact strength
Temperature-dependent resistance (in kJ/m²) of ↗polymer films to a lateral flexural impact (ISO 179: Charpy; ISO 180: Izod); a distinction is made between brittle, semi-impact-resistant, impact-resistant and extremely impact-resistant; the higher the notched impact strength, the better the printability in offset litho.

Number of folds
The number of times a substrate can be folded mechanically without impairing productivity. Depends on substrate ↗thickness and ↗bending stiffness (ISO 5628/9).

Office paper, copy/copier/copying paper
Wood-free ↗uncoated stock used for making copies in copiers, laser and inkjet printers; may be white or coloured; 70 to 150g/m².

Oil absorbency
A paper's receptivity to ink can be determined using the ↗Cobb-Unger method for testing oil absorbency.

One-side coated paper
Often used for jobs where the paper will only be printed on one side. One example is ↗chromo(lux) paper.

Opacity
A substrate's impermeability to light; opposite of ↗transparency; the percentage ratio of the reflectance factors of a single sheet above a black underlay and of a pile of at least twenty sheets (DIN 53146, ISO 2471), radiation impermeability in the UV VIS range (DIN 10050-9); opacity can be increased by using more fillers and a thicker coating slip.

Optical density
Indirect measure of the thickness of an ink film; when measuring density, ↗paper white density must be calibrated as zero.

PA, polyamide
Thermoplastic, a hard version of which can be formed into film suitable for offset printing; often combined with ↗PE in a compound film for food bags; PA 6.6 fibres are used in ↗synthetic paper.

Packaging materials
Materials for primary packaging (outer casing for packaged goods), secondary packaging (visually appealing, stackable display packaging), transport packaging (eg corrugated cartons) and padding; the most common are stiff paper, solid/corrugated board, film and rigid laminates with the necessary chemical resistance and physical durability.

Packaging, flexible
Packaging material with poor ↗crush resistance and relatively soft walls that may be made of a ↗laminate; it is possible to print the base material (sheetfed offset:

Natural-Print packing paper (90 g/m²), printed on the compact KBA Commander CT newspaper press at the *Main-Post* in Würzburg

plastic boxes, luxury paper carrier bags and gift packaging; flexo, narrow web, gravure: drinks cartons, bags, sacks, gift wrapping), the final product (pad/screen printing: plastic bottles and tubes) or labels.

Packaging, rigid

Packaging material with good ↗crush resistance and relatively stiff walls; it is possible to print the base material (sheetfed offset: cartonboard, microflute boxes and displays, metal boxes; narrow web: folding cartons; flexo: pre-printed corrugated [laminated] or post-printed corrugated [direct offset]), the final product (pad/screen printing: caps, seals, glass bottles, wooden crates) or labels.

Paper

A non-woven material with a large surface area and made of cellulose and/or synthetic ↗fibres along with ↗fillers, binding agents and, in some cases, ↗whiteners or dyes; maximum thickness 0.3mm, maximum ↗grammage 150g/m²; the most common print substrate.

Paper sizes, paper formats

ISO 216 (which is based on DIN 476-2, (*table 7*) defines the standard metric sizes of sheet stock for printing; the length divided by the width of all formats is the square root of two, with the surface area of format A0 being 1m². The USA has its own standard sizes.

Paper white

1. In ↗colour densitometry, calibration value 0 for measuring colour density in printed images; 2. White point in the relative colorimetric gamut map when digital proofs are adapted to production stock.

Papermaking, paper production

A mechanical process for making ↗paper and board in the sequence pulp preparation, wire section, press section, drying section (possibly with size press), surface treatment (sizing, coating) and finishing (calendering, sheeting).

Paperonline.org

Educational website and portal link provided by the Confederation or European Paper Industries.

PC, polycarbonate

Thermoplastic from which colourless transparent films can be made; can be used as a substrate in sheetfed offset.

PE, polyethylene

Thermoplastic with a soft, wax-like surface; the hardness and chemical resistance of pure white low-density PE (LDPE) make it an ideal material for carrier bags (narrow web, flexo) and self-adhesive film (also for offset litho), while high-density PE (HDPE) is used as fibre stock for ↗synthetic paper (eg DuPont's Tyvek).

PEEK, polyetheretherketone

Thermoplastic, films of which can be printed in UV flexo and used as food packaging.

PET, PETP, polyethylene terephthalate

Polyester thermoplastic from which it is possible to make fine film with a high degree of tear resistance (flavourseal food storage bags) or drinks bottles with a wall calliper of 500µm; in sheetfed offset it mainly takes the form of ↗lenticular film and film with different levels of ↗gloss front and back; modifications: transparent PET (inkjet/laser printing film, debit/credit card laminating film, deep-drawn film), PETG (polyethylene terephthalate glycol: shrink labels), APET (amorphous polyethylene terephthalate: in barrier compounds), GAG-PET (glycol amorphous glycol polyester: blister packaging).

pH value

Negative common logarithm of OH (hydroxyl) ion concentration; pH <7 = acidic/sour, pH 7 = neutral, pH >7 = alkaline/basic (max. 14); the pH value of paper, board and pulp can be determined using aqueous extracts (DIN 53124: hot; DIN 53124, ISO 6588: cold); paper surfaces for offset printing should be slightly alkaline.

Offset-printed presentation folder with a slip case made of Priplak, a polypropylene film (photo: Papier Union)

Photo paper

Inkjet or laser paper used to print photos; depending on the manufacture and application, it is coated, hard-sized hard paper with a clear transparent ↗PE micro-pore top layer (wipe-resistant, protects against scratches and fingerprints) or bar yta coating (for monochrome prints). Not to be confused with photographic paper, which is coated with light-sensitive chemicals and used for making photographic prints.

Pick(ing) resistance

Perpendicular resistance of the paper or board to surface rupturing or deformation, depends on the size in the paper or ink tack; good correlation between IGT (ISO 3783) and Prüfbau testers.

Pigment

Inorganic or organic coloured solid that imparts colour to paper etc.

Pile, stack

Technologically the best way to store sheets or sections prior to (infeed pile) and after (delivery pile) printing or finishing; the sheets are piled on standardised pallets or trolleys; the use of auxiliary piles allows presses to run continuously.

Pile-logistics system

System that frees pressroom personnel from strenuous logistical tasks (KBA partner: www.krifft-zipsner.de); at its most advanced level it encompasses the delivery of pallets of substrate to the press by roller conveyor, a manual nonstop facility at the feeder, a height-adjustable nonstop roller facility at the delivery and removal of the printed piles by roller conveyor; on straight-on presses pile turners facilitate verso printing.

Piling

Severe build-up of paper dust or ↗coating slip on the rubber blanket; ↗milking, ↗dusting

Pinholes

Small holes in the paper or carton surface which may result in missing dots. In a web product, the holes made by the folding pins.

PLA, polylactic acid

Compostable biopolyester obtained from renewable resources; can be made into hard, high-gloss, high-strength films; can also be printed in offset litho.

Plasma surface treatment

The ion bombardment of non-absorbent metal foils and polymer films in order to increase ↗surface tension and thus ink ↗adhesion; substrates can be pretreated by the manufacturer and remain stable over a long period of time; an alternative to ↗corona surface treatment.

PMMA, polymethylmethacrylate, acrylic glass

A clear transparent or coloured thermoplas-

Table. 7: ISO and USA sheet formats (in mm)

No.	A series	B series	C series	D series	USA traditional formats	ANSI
4A0	1682 x 2378	—	—	—	—	E 864 x 1118
2A0	1189 x 1682	—	—	—	—	D 559 x 864
A0	841 x 1189	1000 x 1414	917 x 1297	771 x 1091	508 x 635 L = royal	—
A1	594 x 841	707 x 1000	648 x 917	545 x 771	431,8 x 558.8 L = broadsheet	C 432 x 559
A2	420 x 594	500 x 707	458 x 648	385 x 545	394 x 489 L = post	—
A3	297 x 420	353 x 500	324 x 458	272 x 385	381 x 508 L = crown	—
A4	210 x 297	250 x 353	229 x 324	192 x 272	304.8 x 228.6 P = 12 by 9	—
long	210 x 99	—	229 x 115	—	279.4 x 431.8 L= ledger, P = tabloid	B 279 x 432
A5	148 x 210	176 x 250	162 x 229	136 x 192	215.9 x 355.6 L = legal	—
A6	105 x 148	125 x 176	114 x 162	96 x 136	215.9 x 279.4 L = letter	A 216 x 279
A7	74 x 105	88 x 125	81 x 114	68 x 96	184.2 x 268.0 L = executive	—
A8	52 x 74	62 x 88	57 x 81	—	76.2 x 177.8 L = $ bill, P = origami	—
A9	37 x 52	44 x 62	40 x 57	—	139.7 x 215.9 L = invoice, half letter	—
A10	26 x 37	31 x 44	28 x 40	—	108 x 139.7 L = quarter letter	—

Tolerance: ±1.5mm up to 150mm edge length, ±2mm from 150 to 600mm, ±3mm over 600mm

L = landscape
P = portrait

Table 8: Substrates handled by KBA sheetfed offset presses

Format (ISO)	KBA	max. format	Standard substrates	Optional substrates	Ink	Coating options
B3 (380 x 520 mm), 2-up	Genius 52UV	360 x 520 mm	Paper/board/film ca. 0.1 - 0.8 mm (substrate-dependent)	—	WLUV	UV
SRA2 (450 x 640 mm)	Performa 66	485 x 660 mm	Paper/board 0.05 - 0.45 mm	—	Oil-based	Aqueous
B2 (500 x 707 mm), 4-up	Performa 74	520 x 740 mm	Paper/board/film 0.05 - 0.6 mm	—	Oil-based, UV	Aqueous, UV
B2 (500 x 707 mm), 4-up	Rapida 74/75	520 x 740/750 mm	Paper/board 0.06 - 0.5 mm	Board/film up to 1.0 mm	Oil, UV, hybrid, WL, WLUV	Aqueous, UV, double
B2 (500 x 707 mm), 4-up	Rapida 74G	520 x 740 mm	Paper/board 0.06 - 0.5 mm	Board/film up to 1.0 mm	WL, WLUV	Aqueous, UV
B2 (500 x 707 mm), 4-up	74 Karat	520 x 740 mm	Paper/board 0.06 - 0.3 mm	Paper/board/ABS, PC, PET, PS, PVC film up to 0.5 mm	WL; film with Zeller+Gmelin Toracard TF	Aqueous, film with Tipadur P-1203 B3
B1 (707 x 1000 mm), 8-up	Ra 105/105u	720-740 x 1050 mm	Paper/board 0.06 - 0.5 mm	Heavy board/microflute/film up to 1.2 mm	Oil, UV, hybrid, WL, WLUV	Aqueous, UV, double
B1 (707 x 1000 mm), 8-up	Rapida 106	740 x 1060 mm	Paper/board 60 - 350 g/m²	Heavy board/film up to 1.2 mm	Oil, UV, hybrid, WL, WLUV	Aqueous, UV, double
5 (920 x 1300 mm)	Rapida 130	910 x 1300 mm	Paper/board 0.06 - 0.9 mm	Lightweight paper from 0.04 mm; heavy board up to 1.2 mm; microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV, double
5B (920 x 1300 mm)	Rapida 130a	965 x 1300 mm	Paper/board 0.06 - 0.9 mm	Lightweight paper from 0.04 mm; heavy board up to 1.2 mm; microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV, double
6B (102 x 1400 mm), 16-up	Rapida 142	1020 x 1420 mm	Paper/board 0.06 - 0.9 mm	Lightweight paper from 0.04 mm; heavy board up to 1.2 mm; microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV, double
7 (1100 x 1600 mm)	Rapida 162	1120 x 1620 mm	Paper/board 0.06 - 0.9 mm	Lightweight paper from 0.04 mm; heavy board up to 1.2 mm; microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV, double
7B (1200 x 1600 mm)	Rapida 162a	1200 x 1620 mm; P 1120 x 1620 mm	Paper/board 0.06 - 0.9 mm	Lightweight paper from 0.04 mm; heavy board up to 1.2 mm; microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous., UV, double
8 (1300 x 1850 mm)	Rapida 185	1300 x 1850 mm	Paper/board 0.1 - 0.6 mm	Heavy board up to 1.2 mm, microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV
9 (1500 x 2050 mm), 32-up	Rapida 205	1510 x 2050 mm	Paper/board 0.1 - 0.6 mm	Heavy board up to 1.2 mm, microflute up to 1.6 mm; film	Oil-based, UV, hybrid, WL	Aqueous, UV

P = shortened format for perfecting; WL = waterless

tic tha t can be formed in to rigid sheets (Perspex, Plexiglas) and e xtruded in to a thick film; printable in sheetfed offset.

Polyester

A ca tegory of thermoplastic ↗polymers containing esters, the most c ommon being ↗PET (poly ethylene t erephthalate). They include PB T (polybut ylene t erephthalate, often used as an insula tor against heat and chemicals), PEN (polyethylene naphthalate, used for beer bottles and sailcloth) and ↗PLA (polylactic acid).

Polymer film, transparent film

Polymer w ebs formed b y injec tion mould ing or ↗extrusion; 20 - 150µm or (mor e typically) 50 - 100µm thick; sold as r olls or sheets; may be tr ansparent or opaque , white or c oloured; surface can be high-gloss, semi-matt or ma tt, structured, pat-terned or ↗lenticular; printable with UV inks, in offset with conventional and water-less inks, in flexo and gravure with solvent- and w ater-based inks; primary applica-tions: folding car tons, flexible packaging , ↗cards and ↗promotional products.

Polymers

Organic macr omolecules based on simple hydrocarbon molecules (monomers) tha t develop useful pr operties, including a high degree of rigidit y, following ca tenation, branching or cr oss-linking; homopolymers (made fr om one t ype of monomer): ↗PE, ↗PP, ↗PVC; copolymers (made from differ-ent monomers): ↗ABS, ↗polyester.

Porosity

Desirable or undesir able pr operty of sub-strates tha t allo ws air , water or oil t o penetrate thr ough sur face holes; affects ↗absorbency and ↗setting time.

Postcard board

Machine-finished, glazed or c oated boar d weighing 150 - 190g/m².

Poster paper

Monochrome paper c oated on one side , with good ↗light-fastness and ↗wet tensile str ength when in c ontact with aqueous glues; poster formats: (*table 9*).

PP, polypropylene

Thermoplastic, weldable syn thetic with a high degr ee of har dness, rigidity and hea t resistance; following c orona treatment it is suitable for printing in conventional and UV offset (eg ArjoW iggins P riplak, overhead projector film); oriented polypr opylene (OPP) and biaxially orien ted polypropylene (BOPP) ar e used for in-mould labels (↗IML), banknotes for tr opical climates or, as solid c ompounds (also moulded or cast: CPP), for food storage bags.

Press format, machine size

Maximum format that can be prin ted on a sheetfed press (*table 8*).

Pressure folds

A mor e adv anced method for t esting ↗tensile strength, routinely at folds cr eat-ed under a specific pressure.

Primary fibres, virgin fibres

↗Fibres tha t ha ve not pr eviously been processed or used.

Primer

A suitable primer c oating or opaque whit e applied t o the sur face of a syn thetic or metallic substrate prior t o prin ting (offset, screen, flexo printing, metal decorating); an alternative to ↗corona surface treatment.

Print quality

Image r eproduction influenc ed b y the homogeneity and ↗brightness of the substrate surface.

Printability

Suitability of a substr ate for prin ting: uni-form ink adhesion and an acceptable visual quality are two key criteria.

Printing ink

Colorant containing substances for creating optical c ontrasts on the substr ate; key properties ar e ↗adhesion and dr ying, which can be influenc ed b y the ↗ab-sorbency of the sur face, and is initia ted according t o differ ent principles: penetra-tion, solvent ev aporation, polymerisation/condensation (UV and IR r adiation), oxida-tion, cooling (skin formation, phase-switch-ing), precipitation (moistur e-set inks) and sintering/melting (ceramic inks, toner).

Printing paper

Any t ype of paper manufac tured for pr o-cessing in the prin ting industry; represents a rising pr oportion of global paper c on-sumption; current trends: more ↗uncoated paper, new haptic pr operties, increased ↗bulk y et lo wer ↗grammage, continuous improvements in prin tability and w ork-ability, eg for use on faster presses.

Printing substrate/material, stock, print carrier

Term applied t o an y ma terial tha t can be printed (paper, corrugated board, solid board, metals, synthetics, glass, textiles); direct printing onto objects is commonly called decorating.

Print-through, strike-through

Partial penetration by the ink in to the sub-strate d ue t o e xcessive s ubstrate ↗ab-

Table 9: Most cost-effective production of poster formats with large-format KBA Rapidas

Poster name	Format	Rapida 130a	Rapida 142	Rapida 162a	Rapida 185	Rapida 205
Mini Quad	31 x 41 cm	8-up	—	—	—	—
Medium	45.7 x 58.4 cm	4-up	—	—	—	—
Double Crown, British Half Sheet	50.8–56 x 76.2 cm	—	—	2-up	—	–
1 Sheet	68.5 x 104.1 cm	—	—	2-up	—	–
Quad Crown	76.2 x 101.6 cm	1-up	—	2-up	—	–
Quad Demy	88.9 x 114.3 cm	1-up	—	—	4-up	–
British 1 Sheet	74 x 151 cm	—	—	1-up	—	2-up
Quad Royal	102 x 127 cm	—	1-up	—	—	2-up
4 Sheet, Single Sheet, Double Quad Crown, Subway	101.6 x 152.4 cm	—	—	1-up	—	–
6 Sheet Decaux, City Light Poster, Abribus	118.5 x 175 cm	in 2 sections	—	—	1-up	–
6 Sheet More O Ferrall, Adshel, TDI, Superlite/Primesite	120 x 180 cm	in 2 sections	—	—	1-up	–
12 Sheet	152.4 x 304.8 cm	—	—	in 2 sections	—	–
16 Sheet Viacom	196.7 x 298.3 cm	—	—	—	—	in 2 sections
16 Sheet	203.2 x 304.8 cm	—	in 4 sections	—	in 2 sections	–
32 Sheet	304.8 x 406.4 cm	—	—	in 6 sections	—	in 4 sections
48 Sheet Viacom	298.3 x 603.1 cm	in 12 sections	—	—	in 6 sections	–
48 Sheet	304.8 x 609.6 cm	in 12 sections	—	—	in 6 sections	–
96 Sheet Viacom	298.3 x 1212.7 cm	—	in 24 sections	—	—	in 10 sections
96 Sheet	304.8 x 1219.2 cm	—	in 24 sections	—	—	in 10 sections

When printing multi-sheet posters an overlap of up to 3cm should be allowed.

sorbency or too thin an ink.

Promotional items, give-aways
Printed products and print-decorated objects typically comprising multiple materials.

PS, polystyrene
Amorphous or semi-crystalline, fully recyclable thermoplastic; a transparent, white or coloured high-impact polystyrene (HIPS) film has high ↗notched impact strength, good ↗dimensional stability, optimum ink uptake (following ↗corona treatment) and good cutting and die-cutting properties.

PTS, Papiertechnische Stiftung
Research foundation (Munich, Heidenau, www.ptspaper.de) providing consulting, training and testing services for the paper industry; affiliated with the FPT (Forschungsvereinigung Papiertechnik, a communications platform) and the FPS (Forschungsvereinigung Papiertechnische Stiftung, which promotes PTS activities); developed the PaperBaleSensor for fast, on-site determination of the moisture, polymer, fibre and ash content of waste paper bales.

Puncture resistance
For packaging materials, this is determined in kJ (ISO 3036).

PVC, polyvinyl chloride
Amorphous thermoplastic, the most common synthetic; softening and ↗antistatic treatment can impair adhesion, which is why only hard PVC (HPVC) film 0.15 to 0.5mm thick is printable in UV offset; it requires pre-treatment to enhance ↗surface tension; printable in all UV and digital printing processes (toner and inkjet, even solvent-based systems); film can be translucent or transparent, white or coloured, have different surface gloss levels front and back; splinter-free cutting and die-cutting, easy to laminate and glue, eg for PVC folding cartons; often modified into PVDF (polyvinylidene fluoride) for packaging film.

PVOH polyvinyl alcohol
Antistatic, weldable, water-soluble, biodegradable, durable packaging film with strong barrier properties against gases, organic solvents and fats.

Quality control
A series of inspections usually undertaken upon reception of printing substrates or packaging materials with the aim of ensuring problem-free processing.

Rag paper
High-grade paper in which at least 10% of the fibre content is composed of textile waste (premium quality, ↗banknote paper), cotton, hemp or flax fibres; rags are also in ↗Bible paper, ↗document paper.

Raw format
Untrimmed sheet size.

Ream
Unit of quantity for paper (*table 10*), 480 or 500 sheets (max. 30kg).

Recycled paper, recycled content paper
Paper (eg for newspapers, packaging, hygiene articles), cartons and cardboard manufactured entirely or largely from ↗de-inked paper waste; the drawbacks are ↗colour cast, deviations in ↗colour tone, and faster ↗ageing.

Table 10: Units of quantity for paper

Printing paper	Current	Previous
Sheet	Basic unit	Basic unit
Quire	25 sheets	24 sheets
Ream, long ream	20 quires = 500 sheets	20 quires = 480 sheets (now referred to as short ream)
Printers ream, perfect ream		21½ quires = 516 sheets
Bundle	2 reams = 1,000 sheets	2 reams = 960 sheets (now referred to as short bundle)
Bale	5 bundles = 5,000 sheets	5 bundles = 4,800 sheets (now referred to as short bale)

Recycling
Recovery and reprocessing of paper and synthetic waste for reuse as printing and packaging substrates.

Reel (UK), roll (US)
The form of substrate required for web printing; specifications include external, internal and core diameter, mass, width and length (which is calculated from these).

Reel-logistics system
System that frees press personnel from strenuous logistical tasks; at its most advanced level KBA's Patras reel-logistics system encompasses the entire paper workflow: ordering, storage and management of the delivered reels, stripping, splice preparation (Easy Splice) and loading on the KBA reelstand, and disposal of expired reels; reels are transported on in-floor tracks and turn tables, supported by unmanned guided vehicles (KBA partner: Rocla).

Relative humidity
For any given ambient temperature, the ratio (as a percentage) of the actual moisture content of the air to the potential moisture content; the relative humidity of the microclimate in the delivery pile or a roll of paper can differ substantially from the room humidity; optimum: 45 to 55%.

Residual strength
The strength of web offset paper after being printed, dried and folded; target value with the ↗Fogra method: >0.67kN/m.

Rheology
The study of the deformation and flow of matter; influences wetting and ↗adhesion of ink to the substrate.

Roughness
Geometric deviation from a perfectly flat surface; opposite of ↗smoothness (*qv* for testing methods).

Runability
The ability of sheets (separability, rigidity, flatness etc) and webs (breaking propensity) to run through a press without causing problems.

Sample book, swatch book
Collection of paper samples.

Sampling
The method for obtaining a representative sample of paper and board to determine the average quality is defined in EN ISO 186, their pre-test treatment in SN EN 20187, EN ISO 2233, ISO 2233 and ENV 12625-2 (↗standard).

SC paper, supercalendered paper
Uncoated web offset wood-pulp paper that has been ↗calendered, ie heavily compressed in ↗thickness, and has a high proportion of filler (↗opacity); used for magazines, supplements and catalogues; grades: SC-B (inline calendered using a soft-nip calender, eg improved ↗newsprint), SC-A (inline gloss-calendered) and SC-A Plus (offline gloss-calendered with Janus MK2 calender).

Scanning electron microscopy
Used to examine the surface of paper for defects, coating cracks and blisters, and a cross section for filler distribution, coating thickness and deposits.

Scorability
The ability of board to be scored without breaking; unlike creasing, scoring destroys the surface coating and superficial fibrous structure.

Scumming, toning
The take-up of ink, from any cause, in non-image areas of the plate; when this starts to occur in offset lithography it is said that the plate is "catching up".

Security/safety paper
Paper with concealed for gery-proof features, eg watermark, metallic thread, applied or integrated taggants.

Self-adhesive paper
Paper with a self-adhesive coating on one side that is protected by silicon-coated backing paper when the front is being printed and until it is used; for labels, stamps, coupons in direct mail.

Set-off, marking, smearing
In sheetfed offset, the transfer of fresh ink from one sheet onto the back of the following one in the delivery pile; in web offset, smearing of poorly dried ink on to the guide, turning or nip rollers.

Sheet size
The maximum (*table 8*) and minimum sheet dimensions of printable substrates.

Sheeter
Rotating cutting device that can be positioned before the feeder on sheetfed presses to allow the press to accept cheaper web stock.

Short grain, CD, cross direction
Where the paper ↗grain runs across the width, ie perpendicular to the machine direction; opposite: ↗long grain.

Show-through
Where the image printed on one side is visible on the other, due to inadequate substrate ↗opacity.

Shrinkage
Loss of substrate volume and dimensions caused by moisture evaporation or cooling; a property exploited in ↗PET sleeves.

Sign paper
Paper for printing simple signs, banners and flyers; generally contains wood pulp and is heavily sized.

Silicon paper, silicon treated/release paper
↗self-adhesive paper

Single-coated paper
Paper with a single application of coating slip; the most common form of coating.

Sized paper
Paper that has been made more resistant to moisture by adding starch, resin and wax to the pulp (beater-sized paper) or by size-press coating (↗FC paper), which improves the bond between ↗fibres and ↗fillers; well-sized paper can be printed easily and does not suffer from ↗dusting or ↗picking.

Skin packaging
Packaging, eg an offset printed ↗folding carton, with a clear, unprinted, deep-drawn plastic skin shrunk onto it; the skin and carton are bonded with a heat-sealed coating (blister coating).

Slur
A faint, out of register duplicate of a printed image, resulting from the transfer of the image onto the blanket cylinder in the next printing unit. Caused by fault y press settings or paper with the wrong ↗grain.

Smoothness
Haptic property of substrates with a low friction coefficient, created by the calendering, smoothing and chrome cylinders in the papermaking or coating machine; opposite of ↗roughness and thus an indication of the printability (less ↗adhesion); in processes where the air flow is subject to defined pressure, the measurement of smoothness and roughness is identical, eg the Bekk method (in sec, ISO 5627), the Parker print-surf method (in µm, DIN ISO 8791-4), the Bendtsen method (in mPas, ISO 5636-3, DIN 53108), the Gurley method (in ml/min, ISO 5636-5) and the Sheffield method (in ml/min, ISO 8791-3); optical laser measurement eg with UBM microfocus (DIN 4768).

Solid board
↗Board made from identical layers of paper couched together (millboard) or different layers glued together and faced with a high-grade liner (mechanical board); most common material used for book covers.

Specific volume, specific bulk
Absolute ratio (in cm^3/g) between a substrate's ↗thickness and ↗grammage (EN

Table 11: Processes and standards for measuring brightness/whiteness and yellowness

Brightness/ whiteness	Standard	Measuring geometry	Illuminant/observer	Basis	Parameter	Interpretation
ISO brightness	ISO 2470,	Diffuse/0° (Elrepho 450X)	C/2°, D65/10° with and without UV cut filter	CIE xyY (1931)	W (with illuminant/observer)	Ideal value 100%; with whitener > 100%
ISO brightness	ISO 3688	Diffuse radiance factor	Blue light (457 nm)	IR3 reflection standard	W (blue light)	Ideal value 100%
CIE brightness	ISO 11475	45°/0° or 0°/45°	D50/2°	CIE xyY (1931)	$W_{CIE} = Y + 800\,(x_n - x) + 1700\,(y_n - y)$	Values 90 - 120; the higher the brighter
Degree of colour deviation	ISO 11475	45°/0° or 0°/45°	D50/2°	CIE xyY (1931)	$T_W = 900\,(x_n - x) - 650\,(y_n - y)$	Colour cast, yellowing
Hunter whiteness	—	45°/0° or 0°/45°	D65/2°	CIE XYZ, HunterLab (1958)	$W_H = L - 3\,b_L = 19.29\,[(Z - 11\,Y) / Y^{1/2}]$	Ideal value 100
Stensby whiteness	—	45°/0° or 0°/45°	D65/2°	HunterLab (1958)	$W_S = L + 3\,(a_L - b_L)$	Ideal value 100
Berger whiteness *	—	Reflectometer 45°/0°	D65/2°	RY, RZ, RX = f {CIE XYZ}	$W_B = Y + 3\,(1.1333\,Z - 1.2985\,X)$	Ideal value 100
Taube whiteness *	—	45°/0° or 0°/45°	D65/2°	CIE XYZ (1931)	$W_T = 3.6734\,Z - 3\,Y$	Ideal value 100
ASTM whiteness	ASTM E313	45°/0° or 0°/45°	C/2°, D50/2°	CIE XYZ (1931)	$WI_{E313} = 3\,(1.242\,Z - Y)$ *with C/2°*	Ideal value 100
Yellowness	DIN 6167	45°/0° or 0°/45°	C/2°, D50/2°	CIE XYZ (1931)	G_{1925} (corresponds to ASTM D 1925)	Yellowing: G > 0 yellowish, G < 0 bluish

** Outdated process*

ISO 534); there is a shift towards a larger volume with the same grammage (cheaper than thicker, heavier paper) or a lower grammage with the same volume (to reduce postage costs for direct mail and mail-order catalogues).

Spectroscopy
Infrared method for identifying organic compounds: FTIR (Fourier transform infrared) for resins, glues, binding agents and additives, and NIR (near infrared) for fillers, sizes and coating binders.

Splice
In web printing, the join between the expiring web and the new one; KBA offers automatic splice preparation with Easy Splice.

Splitting
An extreme form of picking in which the pull of a thick, tacky ink tears off large portions of a paper's or a board liner's surface, which then adhere to the offset blanket and may cause damage.

Standard atmosphere
Relative air humidity 50% ± 5% at a press hall temperature of 23° C (EN 20187, ISO 187).

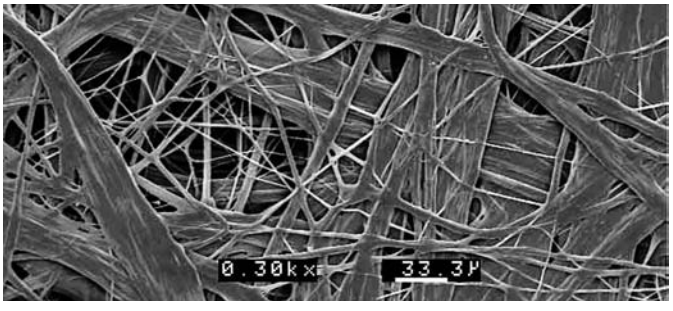
Static electricity
An electrical charge that builds up on the surface of poorly or non-conductive paper and film, due to a dearth (+) or excess (–) of electrons; causes the sheets to stick together, making it difficult to separate and stack them.

Static eliminator, antistatic system
System of heads, nozzles, electrodes and arrays for discharging ↗static electricity during sheet or web travel; primarily used with synthetic substrates; KBA supplier: Kersten Elektrostatik (www.kersten.de).

Table 12: Film surface tension

Polymer film	Surface tension*
ABS copolymer	35 - 42 mN/m
PA 6	34 - 57 mN/m
PBT**	30 mN/m
PE**/**	31 - 36 mN/m
PEEK	44 - 46 mN/m
PEN**	30 - 39 mN/m
PET	43 - 47 mN/m
PC**	33 - 47 mN/m
PLA (bioplastic)	50 mN/m
PMMA (Perspex)	33 - 49 mN/m
PP**/**	29 mN/m
PS	43 - 44 mN/m
PVC**	36 - 39 mN/m

** The substantial deviations arise from non-standardised testing conditions and the use of different additives. ** Corona surface treatment essential. *** Except for UV, only printable with special inks for polyolefines.*



Polyethylene fibres in DuPont's synthetic paper Tyvek under a scanning electron microscope (photo: www.IRFIP.fr)

Stationery
General name given to paper and office supplies such as envelopes, notepads, pens, pencils, erasers, greeting cards, paper clips, drawing pins etc.

Stretch
Dimensional change caused by the application of force, heat or moisture parallel or perpendicular to the ↗grain in paper or board, or differences in the preferred orientation of polymer molecules (tacticity); the stability of isotactic polymers (eg ↗PP) can be enhanced by stretching.

Stretch at break
Percentage by which a substrate stretches prior to breaking (↗breaking length), relative to its unstretched length (EN ISO 1924-2: stress-strain curve: ↗elasticity modulus, fracture toughness (in J/m), fracture toughness index (in Jm/kg).

Surface strength
Property of offset paper that influences sizing, picking and dusting.

Surface tension
Here: atomic interaction of the ink with the substrate surface in an air or ↗inert gas environment; metal and polymer films (*table 12*) may have too low a surface tension, causing ink to bead and roll off; it can be remedied by applying an ↗adhesive primer or ↗corona surface treatment; testing ink: spreading, contact angle measurement (Fogra, TAPPI 558).

Surface/tub/top/vat sized paper
↗uncoated stock that has had its strength and water resistance enhanced by dipping it in a gelatine and starch solution.

Swell
In bookbinding, the increased thickness of a text block along its spine edge after being stitched.

Swelling
An increase in the volume of paper and board through moisture absorption and of synthetics through heat and/or solvent absorption.

Swell paper
Paper on which dark-printed areas form a tangible profile when subjected to heat; printable in offset litho.

Synthetic fibre paper
Paper impregnated or coated on one or both sides with synthetic fibres, or with synthetic fibres added to the pulp.

Synthetic paper
Highly tear- and water-resistant, dimensionally stable paper made from welded polymer fibres or extruded film; polymers: BOPP (biaxially oriented polypropylene), PA (polyamide), PE (poly ethylene, DuPont's Tyvek), polyester, viscose fibre. Also sheet material, resembling paper, made from synthetic filaments by other means, eg spin bonding. Plastic material in sheet form, surface-treated to make it suitable for commercial printing.

Synthetics, plastics
Common term for synthetic and semi-synthetic ↗polymers; a distinction is made between thermoplastics (malleable when warm, eg PVC, PP), thermoset plastics (once set, they cannot be remoulded, eg phenoplasts, PUR, hardened epoxides) and elastomers (all types of rubber that are malleable when cold); thermoplastic film is the only synthetic suitable for printing; it can also be blow-moulded in to hollow beads for use as a packing material.

TAPPI, Technical Association of the Pulp and Paper Industry
American-based global research association (www.tappi.org) whose test specifications and specialist publications are respected the world over.

Tear resistance/strength
Resistance (in N) to tensile force; derivations: tear index (in mNm^2/g), stretch at break (in %); plastic and film: ISO 6383-2, paper: ISO 1974, BS EN 21974: ↗grammage-specific determination of tearing resistance in mNm^2/g using the Elmendorf method).

Tensile strength
Determined in accordance with DIN EN ISO 1924: the quotient (in kN/m) of the breaking load and the width of a paper strip, and thus by derivation the tensile modulus or stiffness (in N/m); tensile stiffness index (in Nm/k g) is the quotient of the tensile stiffness and the ↗grammage.

Tensile strength, breaking load
The maximum stress a substrate can stand when pulled at both ends (EN ISO 1924-2).

Test liner
Liner made of secondary fibres (125 to $180g/m^2$) and used to make corrugated and solid board; coated (suitable for printing corrugated in direct offset) or uncoated.

Testing devices, testers
Indispensable systems or sensors for testing the quality and properties of substrates; main suppliers: www.emco-leipzig.com, www.fogra.org, www.igt.nl, www.pruefbau.de, www.ptspaper.de, www.tappi.org.

Textile/cloth printing
The printing of lengths of cloth, articles of clothing and outdoor advertising media (flags, banners, cladding) on screen and digital presses.

Thermal properties
Key threshold values when using and printing ↗polymer films. They include the temperature at which they are workable, at which they will shatter with cold or decompose, and their coefficients of thermal expansion (DIN 53453) and thermal conductivity.

Tin plate
Steel rolled in to thin sheets (<0.5mm thick) and coated electrolytically with a layer of white tin; along with ↗aluminium the most common packaging material used in ↗metal decorating.

Totally chlorine-free paper, TCF paper
Environmentally friendly ↗uncoated stock produced from pulp bleached without the use of chlorine (TCF label).

Translucency
The state of permitting light to pass through partially or diffusely; semi-transparency (cf ↗transparency). A property of films and low-filler paper.

Transparency
The property of a substrate that allows light to pass through; the opposite of ↗opacity; ratio in % (DIN 53147) of the radiance factors of a single sheet of the substrate over a black underlay (RS) and a white underlay (RW), and of the white underlay (RWU): T = (RW – RS) [(10000 / RWU) – RS]; objects behind a transparent substrate can be seen more clearly than behind a ↗translucent one.

Transparent paper
Paper with a high level of ↗transparency and a low level of absorbency; in offset litho thick, stiff (also coloured) transparent paper is a popular alternative to ↗polymer films.

Two-sidedness
Property of paper reflecting the difference in texture (↗smoothness), appearance and printability between the side of the paper in contact with the papermaking machine's forming wire (wire side) and the side away from the forming wire (felt side).

UG paper, unglazed/unfinished paper
↗machine-finished paper

ULWC/LLWC paper, ultra/light lightweight coated paper
Web offset or gravure paper coated on both sides and weighing less than 45g/m²; primarily used to print mail-order catalogues.

Uncoated paper/stock
Paper with or without a surface treatment, pigmentation (up to 5g/m²) or colour (DIN 19300: wood-pulp, dyed); its manifold tactile properties make it a popular substrate in offset litho.

Units of paper quantity
The customary units used in the paper industry can be found in table 10.

UV radiation
Ultraviolet range of the electromagnetic spectrum (approx. 100 - 370nm, invisible); uses include curing specially sensitised inks and coatings on non-absorbent substrates, bleaching substrates (↗whiteners) and inks (fluorescent inks).

Waste disposal technology
Peripheral systems used in print production and finishing for the removal, collection and/or bundling of paper waste, used materials et al (eg baling presses, crushers) and the extraction and/or recovery of airborne emissions.

Measuring CIE whiteness and ASTM yellowness with Techkon's SpectroDens Premium (0°/45°)

Waste paper
Used paper prior to recycling or disposal.

Waste, reject sheets, spoilage, misprints
Unsellable printed sheets or sections of web.

Water absorbency
↗Cobb test/method

Water resistance
Resistance of a substrate over time to penetration by water. ISO 15106 determines the water vapour transmission rate using four different methods, ISO 3038 and FEFCO 9 apply to the glue bond in corrugated fibreboard.

Watermark
A genuine watermark is a design stamped in the wet paper pulp as it is forming in the papermaking machine, either with a wire mould in the vat or by running the wet web under a dandy roller. This compresses the paper, decreasing its opacity in the image area of the design, which becomes visible when the dried paper is held up to the light. Semi-genuine watermarks are made with an engraved roller in the drying section, fake ones with a transparent overprint.

Waterproof paper
Paper with a waterproof coating (DIN 54515); difficult to print.

Weather resistance
The degree to which ↗polymer films (outdoor advertising, compost bags) and ↗poster paper are resistant to light (↗light-fastness), water (↗hygrostability) and ↗ageing.

Useful web addresses

Metal decorating: mpma.org.uk, empac.eu
Print/media: pira.co.uk, gain.net, cpia-aci.ca, printnet.com.au, printmedia.org.za
Flexible packaging: flexpack.org, flexpack-europe.org, eurosac.org
Folding cartons and corrugated: ecma.org, procarton.com, fefco.org
Paper industry: cepi.org, prima-papernetwork.org
Paper, board and plastic processing industries: citpa-europe.org
Packaging institutes: worldpackaging.org
Solid board: esbo.nl,
Corrugated board: fefco.org

Web tension
This must be controlled in order to avoid web breaks.

Web-breaking propensity
Inability of a paper web to withstand vibration or start-up tension.

Wet picking
Sudden reduction in ↗picking resistance; caused by vomoistening in offset print production.

Wet strength
Property of paper that can be enhanced by mixing alkali-resistant additives in the pulp.

Wet tensile strength
The ability of paper to resist spreading or elongation when subjected to moisture; important for ↗poster paper (application of glue) and web stock (fan-out potential); can be measured with ↗emcoDDPM expansion module. ISO 3781: tensile strength after immersion in water.

Wettability
Controlled by adjusting the ↗surface tension of non-absorbent substrates; aids: wetting angle measurement with water or oil (↗Fogra projector, ↗PTS-PP:103/85), run-off test inks.

Whitener, brightener, fluorescent whitening agent, FWA
A colorant added to paper and fluorescent inks that makes the invisible ↗UV-A rays (<380nm) in daylight turn blue, causing more visible light to be reflected than is incidental.

Whiteness (index), brightness
Measure of the brightness and achromaticity of paper and board; various definitions and measuring procedures are in use (*table 11*) for factoring in the phenomenon that a bluish tone imparts a whiter impression (↗whiteners).

Winding tension
The uniformity of the tension at which a paper web was wound on the core affects the quality of the printed image when the web runs through the press, and can be tested by tapping the web at various points across its width. The more uniform the sound, the more uniform the tension.

Wire-side, underside, wrong side
The side from which water drains from the pulp in the wire; normally, but not necessarily, the side that prints less well; ↗two-sidedness.

Wood-free paper, groundwood-free paper
In theory, paper that contains no mechanical wood pulp. In practice, paper that contains less than 5% mechanical wood pulp; uncoated paper has seen the strongest growth, primarily on the back of spiralling demand for ↗office paper and bulky ↗book-printing paper; the most popular types of coated paper are ↗art and ↗carbonless copy paper, while demand is declining for ↗LWC paper.

Wrinkles, creases
Quality flaw in papermaking; in printing, the result of uneven tension on the web at the rollers in the superstructure, the cylinders in the printing unit etc.

Writing paper
Well-sized and calendered ↗uncoated stock or ↗handmade paper that is suitable for writing on both sides; 60 - 90g/m².

Yellowing, yellow discoloration
Yellow to brownish discoloration (DIN 6167) of paper, board or coatings caused by chemical reactions within the fibrous structure (↗lignin) or with ink components (↗ghosting); atmospheric oxygen, heat and daylight are all conducive to yellowing.

Zellcheming
The Association of Pulp and Paper Chemists and Engineers (www.zellcheming.de) in Germany; publishes reference pamphlets on paper manufacture (PMAK), paper testing (TEST), paper finishing and carton conversion (CONV), carton and board manufacture (PBTC) and paper recycling (RECO).

Dieter Kleeberg

Dieter Kleeberg
Dresdener Ring 60
61130 Nidderau, Germany
Tel: (+49) 6187 3153
dieter.kleeberg@t-online.de

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Translated by Christina Degens-Kupp

Koenig & Bauer Aktiengesellschaft
Würzburg Facility
97010 Würzburg, Germany
Tel: (+49) 931 909-0
Fax: (+49) 931 909-4101
www.kba.com
kba-wuerzburg@kba.com

Radebeul Facility
01439 Radebeul, Germany
Tel: (+49) 351 833-0
Fax: (+49) 351 833-1001
www.kba.com
kba-radebeul@kba.com

KBA-Metronic AG
Benzstraße 11
97209 Veitshöchheim, Germany
Tel: (+49) 931 9085-0
Fax: (+49) 931 9085-100
www.kba-metronic.com
info@kba-metronic.com

KBA
Koenig & Bauer Group