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An investigation into the quality of fluting-paper at papermills

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APPENDIX 3.2

PAPER TESTS

Property	Description	Unit of Measure	Procedure reference
Tensile Strength	This test assesses the ability of the paper to withstand strains applied to it and is an indication of the performance of the paper when subjected to shock loads. The paper is subjected to a constant rate of elongation during the test and the instrument measures the tensile force until the paper ruptures.	kN/m.	ISO 1924-2 p229
Stretch	Stretch or stretch elongation is the amount of distortion the paper will undergo under tensile stress. Stretch is related to the paper's ability to conform and maintain conformance to a particular contour. Stretch is performed on the tensile tester that applies a constant rate of elongation to the paper. It is a measure of the percentage increase in length of the sample to the original length.	%	ISO 1924-2, p229
Coefficient of friction	This test gives an indication of the ease of which a paper will slide over another paper surface, when in contact with each other. It is measured on an apparatus designed to slide two pieces of paper against each other with a constant pressure and measure the forces (static and kinetic friction) needed to start and maintain the sliding.	ratio	ISO 15359 p1541
Internal tear	The internal tear resistance of a paper is its ability to resist tearing when an initial flaw is inserted on the paper and a force is applied along the flaw. This is particularly important for papers, which may be subjected to such tearing forces for e.g. when boxes are transported. Tearing resistance is measured on an instrument called an Elmendorf Tester.	mN	ISO 1924-2 p229

Flat crush	This test performed on fluting presents the compression force that the fluting can handle before collapse, and is important in understanding the crushing forces a box can withstand when the particular fluting is used in its construction. This test is fundamental as it provides useful information for the construction and the design of the corrugated box. It is also an early indication for determining whether the compression strength is the reason for collapsing boxes and whether the fluting is fit for its intended application.	N	ISO 7263 p1019
Ring crush	A piece of fluting is formed into the shape of a cylinder and a compression load is applied to the edge of the fluting to perform this test. This test measures the edge crush resistance of a piece of board and indicates the stacking strength of the boxes, especially useful for when boxes are stored in warehouses or are being transported.	KN/m	ISO 12192 p1447
Porosity	Porosity or air-permeance is an indication of the amounts of voids in a paper's structure that allow the permeability of air and liquids and have an influence in the manner in which the paper behaves during converting processes like gluing, flute tip formation and bonding.	m/ pa.s	ISO 5636-3 p891
Moisture	The moisture content is measured by weighing a piece of paper, then drying it in an oven at 105^{o}C and reweighing the paper. The difference in the weight is the moisture. Moisture content has financial implications as the higher the moisture content, the lower will be the paper mass that a customer receives. Most physical properties of paper for example, strength, cracking, glueability, flute tip formation, bonding and runnability in the case of fluting, undergo change as a result of variations in moisture content, as water has an effect of relaxing and weakening the fibres and fibre bonds.	%	ISO 287 p41
Grammage	Grammage is measured by weighing a known area of paper, on an air-dry basis. This property is significant, together with thickness and moisture in the sale of the paper, and influences the physical properties of the paper. Papermakers will always aim to get all desired properties of paper with minimum possible basis weight, while the customers will always want the highest possible grammage.	g/m^2	ISO 536 p85

Thickness	Paper thickness is measured with a micrometer, and is a key characteristic in paper properties such as strength and opacity. For a given grammage, thickness determines how bulky or dense paper is.	m	ISO 534 p67.
Bending resistance	This is the force required to bend a piece of paper. The test piece of paper which is 50mm in length is deflected through 15^0 when this test is performed.	N	ISO 2493 p295
Brightness	Brightness is defined as the percentage of the reflectance of an opaque pad of tests sheets compared to the reflectance of the perfect diffuser. A reflectometer is used to measure brightness, which is an indication of the aesthetic appeal of the paper.	%	ISO 2470 p269
Colour	It is often a requirement that the colour of paper must match a commercially agreed upon sample. Colour of paper is not a physical property but rather a perception by the observer and thus colour depends not only on the sample but also on the conditions under which it is viewed and the observer. Colour is measured with a spectrophotometer, which makes measurements across the entire range of the visible spectrum and produces results from the reflectance values that it measures. The results are presented as CIE tristimulus values that represent colour in a three dimensional space.	L*, a and b values	ISO 5631, p 849
Smoothness	The smoothness or roughness of a paper is the measure of the contours of the paper's surface. Roughness is the opposite of smoothness. Smoothness is measured using an air-flow measurement instrument, which is based on the principal that the volume of air voids between a paper and a plane surface is proportional to the roughness of the paper and the rate of airflow between these surfaces is proportional to the volume of air voids.	ml/min	ISO 8791-2, p 1137
Cleanliness (dirt)	The dirt specks or contraries can be any unwanted foreign particle that is visible to the eye such as bark, undigested wood, plastic, slime, etc. The paper is inspected on both sides under reflected light, and specks larger than $0.04mm^2$ are counted and classified according to area using a transparent film with spots of known area but having different shapes and sizes.	mm^2 per m^2	ISO 5350-3 p755

Water flotation	This test which indicates the time it takes for a fluting specimen to be saturated when allowed to float in a vessel of water relates to the way the paper can be steamed during the corrugation operations.		Tappi method T832
Cracking	There is no procedure for analysis of cracking. Cracking is assessed visually. It usually occurs as a problem during converting operations.	No test	No test
Glueability	There is no standard test that exists to quantitatively assess this property. Glueability is dependent on properties of the paper such as grammage, moisture, porosity and water flotation. It is the ability of a piece of paper to be adhered to another.	No test	No test
Printability	There is no ISO standard test to assess printability, although several qualitative non-standard tests exist, for example the Prufbau printability tests is well known in the paper industry for assessing the quality of the high quality printing grades of paper. The application of printing analysis is minimal for corrugated container.	No standard test	No standard test
Warp	There is no standard test that exists for warp.	No test	No test
Curl	Paper curl can be defined as a deviation of a sheet of paper from a flat form. Curl results from the release of stresses that are introduced into the sheet during manufacture and subsequent use. Curl is measured using a non-standard test called star curl. A template of a star is used to cut a star from the paper. This deviation of the ends of the star from the flat surface is measured, using a vernier caliper and the curl is expressed in millimeters.	mm	In-house test refer to appendix 3.1