Newsprint properties and specification list for newsprint purchase and how to establish a quality control programme for newsprint

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Newsprint properties and specification list for newsprint purchase and how to establish a quality control programme for newsprint. (1995). In Newsprint and Newsink Economy and Quality in the Face of Rising Prices : Workshop, Hong Kong 13-14 June 1995. Singapore: Asian Media Information & Communication Centre.

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Newsprint Properties And Specification List For Newsprint Purchase
&
How To Establish A Quality Control Programme For Newsprint

Session 4:

Newsprint properties and specification list for newsprint purchase

Overview of the important properties related to newspaper production

How to establish a quality control programme for newsprint

The different steps towards quality control

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PHYSICAL PROPERTIES OF NEWSPRINT

Basic characteristics

- Grammage
- Moisture content
- Ash content

Structural characteristics

- Sheet thickness
- Sheet density
- Surface roughness, smoothness
- Compressibility
- Hardness
- Porosity, air permeability
- Oil absorption
- Water absorption

Optical characteristics

- ISO brightness
- Shade
- Opacity
- Light scattering coefficient

Mechanical characteristics

- Tearing resistance
- Tensile strength and elongation
- Tensile strain energy absorption

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NEWSPRINT GRAMMAGE

- Also called "basis weight" or "substance"

- **Definition:** mass of the paper per unit surface area of the sheet in the "as-taken" condition, i.e. with the moisture content with which the paper left the final stage of the papermaking process

- **Units:** SI Units: kg/m2

Preferred units: g/m2

American: Pounds/ream (lbs/ream)

--> The weight in pounds of a ream (500 sheets) of newsprint 24 by 36 inches (3000 square feet)

- **Recommendations:** The standard newsprint grammages are

48.8 g/m2 *(american equivalent: 30 lbs/ream)*

45 g/m2

40 g/m2

If a printer wants to use a higher grammage than 48.8 g/m2, he should use **52 g/m2**.

If a printer wants to use a grammage between 40 and 45 g/m2, he should use **42.5 g/m2**.

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General trend: grammage reduction

- In the 70s and before: global standard 52 g/m2
  Since that time, trend to decrease
- In 1974, sudden change from 52 to 48.8 g/m2
  because of energy costs

Advantage of lower grammage:

- more web length per reel for a given diameter
- fewer reels for a given tonnage (less reel stub waste and strippings)
- reduced weight per copy: reduction of postal and freight costs
- thinner paper: higher pagination possible

Parameters for a decision in grammage reduction:

- type of product (esp. use of colour)
- Print quality (press characteristics)
- distribution characteristics (postal prices for ex.)

--> An estimation has to be made individually for each newspaper

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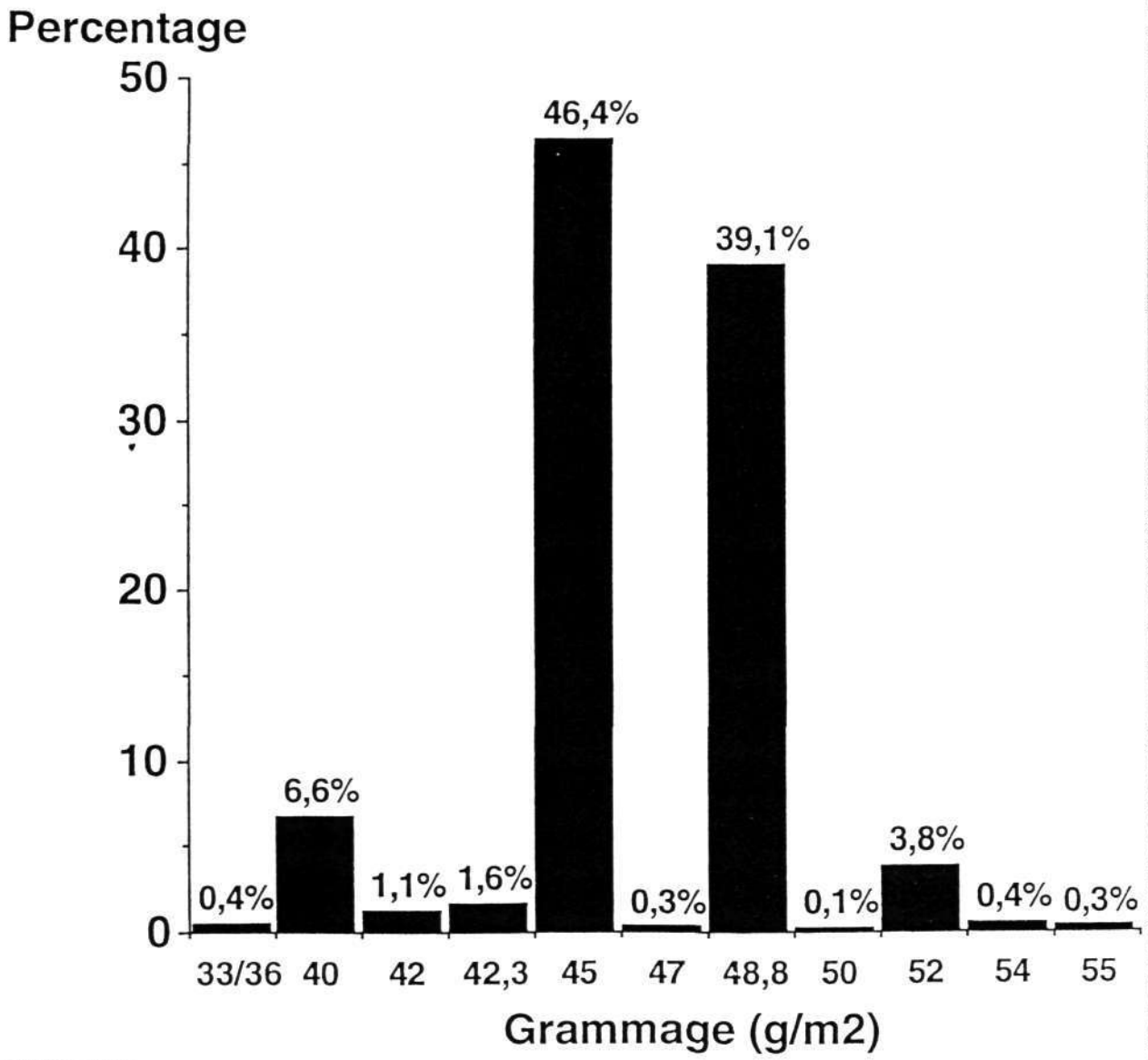
Questionnaire
Newsprint Reel Characteristics

Tonnage produced from the different grammages



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Grammage variations

It is a concern:

- for the runnability of the paper in the press
- because it is cost factor (influences the number of copies printed for a given tonnage.

Possible variations:

- between reels
- in the length of the same reel
- across the width of a reel

- If the actual grammage of a consignment is greater than the specified value, the printer is paying more than he would otherwise expect.
- If the real grammage is below the specified value, there is a cost advantage for the printer but some problems can appear during printing (drop in production performance)

What should be done?

It is not sufficient to specify the nominal grammage. A **tolerance** should also be agreed between the printer and the paper manufacturer.

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Moisture content

- **Definition:** Reduction in mass of a paper sample when dried expressed as a percentage of the mass of the moist sample.

- **Units:** Dimensionless - Expressed in %

- **Recommendations:**

  Should not be less than 8%.

  For newsprint grades with high filler content, can go down to 7%.

  Should not exceed too high values.

- **Determination:** Samples in the "as taken" condition (with no preconditioning). Determination with ISO 287.

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Moisture content

- Moisture affects the mechanical and printing properties of the paper

- After the paper machine, moisture between 5 and 10%

- On the press rapid and variable stresses:
  - Low moisture content:
    --> the paper loses elasticity
    --> more web breaks
    --> more static electricity
    --> web control more difficult
    --> build-up of fibres on blankets.

Good moisture control: better paper compressibility, better print result

- The paper should be in equilibrium with the ambiant air.

- Moisture problems are more important in offset than in letterpress

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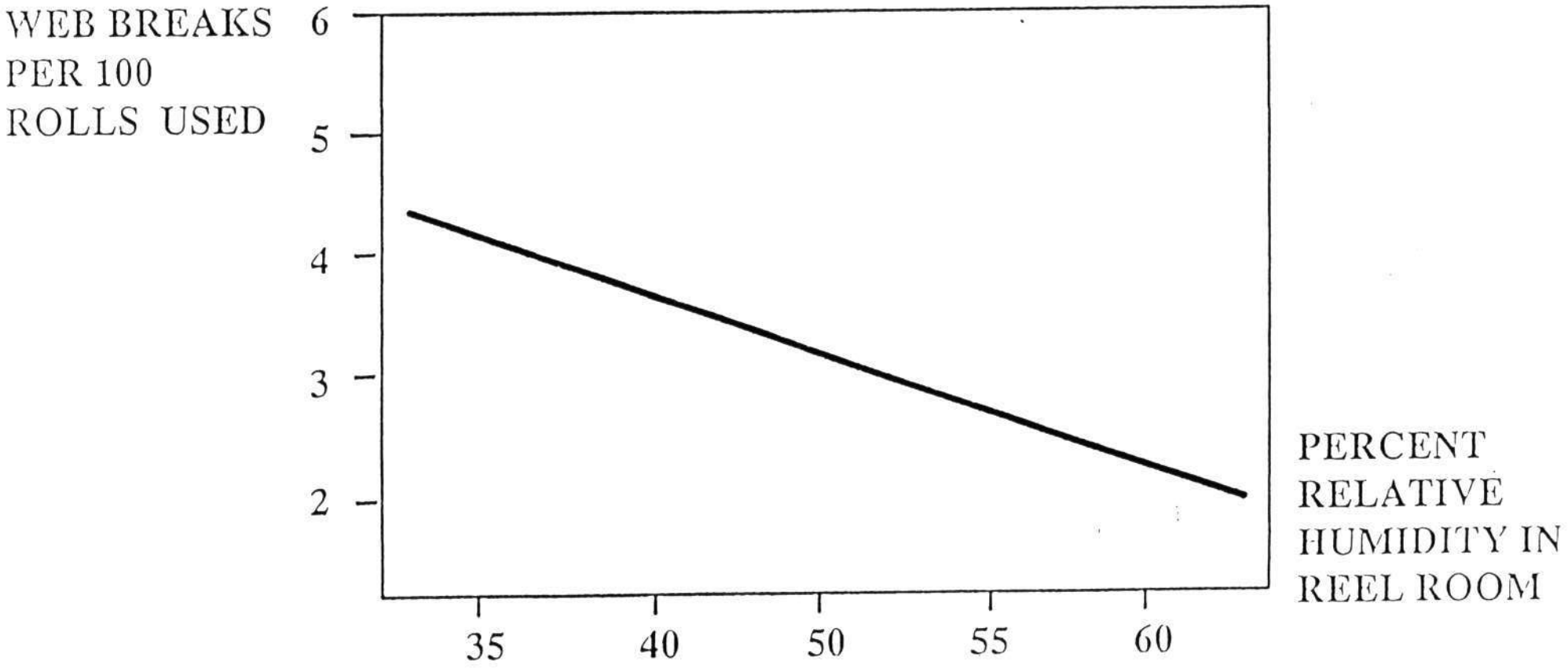
As Humidity Increases Web Breaks Drop



Moisture content increases due to damping application on the press

- Blanket-to-blanket configuration (1 colour): +1% of water on each side of the paper.

- Four-colour printing: +4%

- 4-over-4 colour printing: up to +8%

--> This has an influence on press performance (particularly in the folder)

--> Register problems

IFRA Research Project: Register stability of newsprint under damping application in collaboration with TFL (Swedish Newsprint Research Centre) in Stockholm.
Aim of the project: study the expansion of newsprint under damping application and propose solutions to counteract.

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Ash content

- **Definition:** Content of mineral (inorganic) matter in the finished sheet.

- **Determination:**
  Determined by incineration of the paper. Expressed as a fraction of the original (moisture-free) mass of the paper

- **Units:** Dimensionless quantity
  Expressed in %

- **Recommendation:**
  - Generally: 0-12%
  - Some users specify an upper limit (especially when long plate runs are necessary because of abrasion)

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Different types of fillers

Filler type	Chemical nature	Density (g/cm^3)	Brightness	Ignition loss (% at 900°C)
Kaolin	Aluminium silicate	2.4—2.7	70—90	12—14
Talc	Magnesium silicate	2.6—2.9	70—88	4—6
Calcium Carbonate	$CaCO^3$	2.7—3.0	93—98	38—42

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Ash content

- The **ash** can come from:
  - residue of additives (chemicals) added during papermaking
  - mineral matter in the pulp (comes from the wood)
  - filler material added by the papermaker
  - filler or coating pigments from waste paper (recycled newsprint)

--> **Advantage** of loading the paper with fillers: improves brightness, opacity and smoothness.
For newsprint, mostly kaolin (china clay)

--> **Disadvantage**: reduction of the mechanical properties.

If ash content < 2%: no loading, virgin-fibre newsprint
If ash content > 8-10%: recycled newsprint

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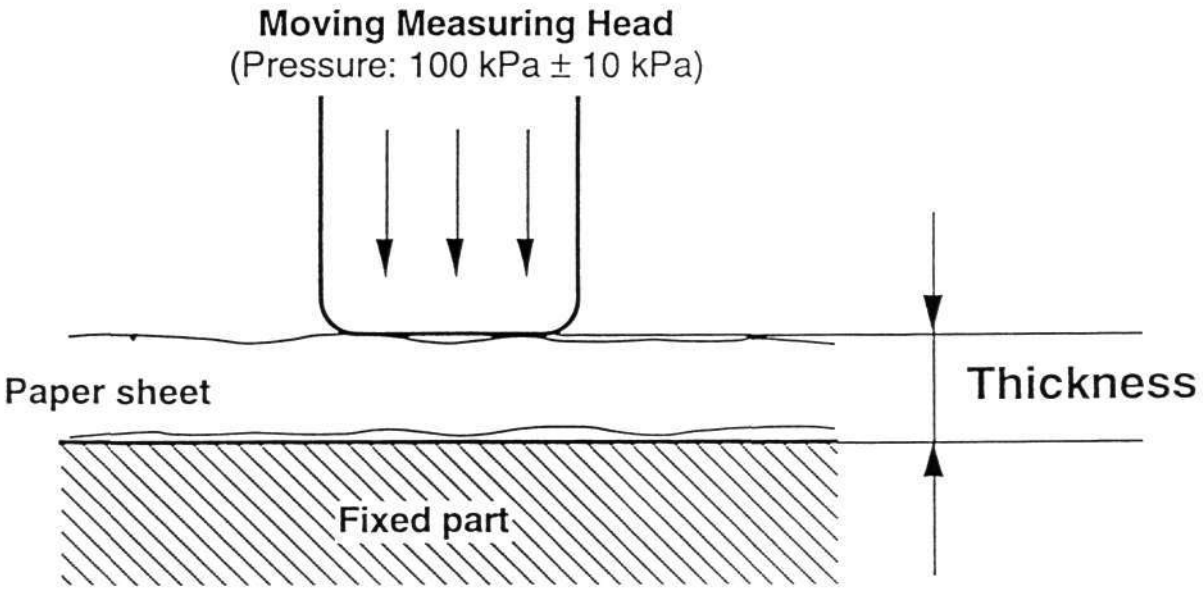
SHEET THICKNESS

- **Definition:** Thickness of a single sheet
The term "caliper" is also used.

- **Units:** Micrometer (μm)
1 μm = 0.000001 m = 1/1000 mm

- **Determination:** According to ISO 438



- **Recommendation:** No special recommendation (depends on manufacturing conditions and furnish). The variations should be kept to a minimum.

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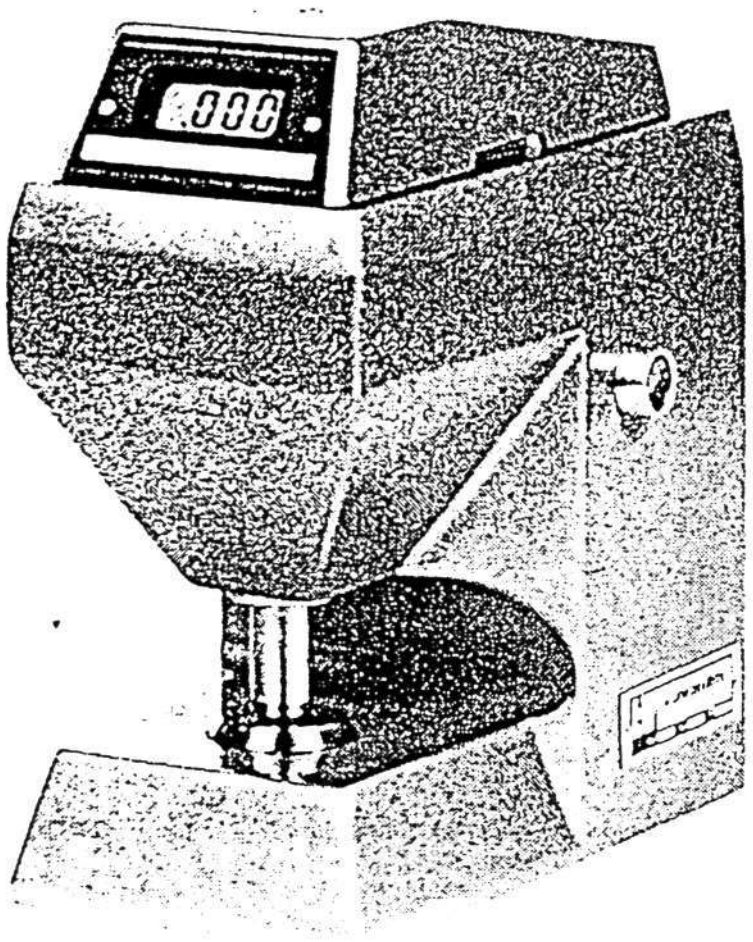
For rapid and accurate measurement of the thickness of paper, board and plastic.



Type D2 with digital display.
Easy-to-read digits, 12.7 mm (1/2") high.

SHEET DENSITY

- Definition: Specific mass of the paper sheet, i.e. the ratio between the mass of a sheet and its volume.
As it includes voids (open and closed), it is an "apparent" density
The **"bulk"** is the reciprocal of the density.

- Units: SI units: kg/m3
Preferred units: g/cm3

- Determination:

Density (g/cm3) = G/T
where: G: Grammage (g/m2)
T: Thickness (µm)

- Recommendation:

No general recommendation

- Remark: Average density of a consignment = average of the densities of the samples (and not average grammage divided by average thickness)

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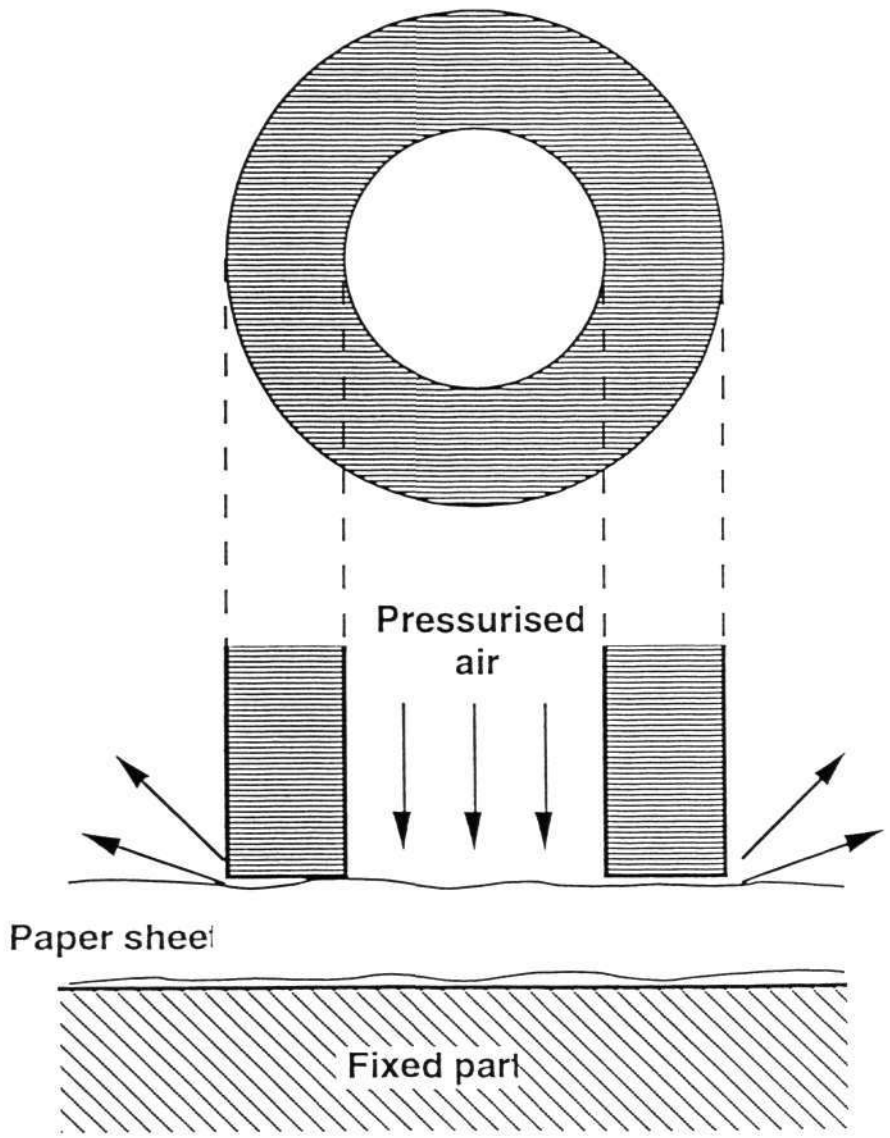
SURFACE ROUGHNESS - SMOOTHNESS

- Definition: Physical irregularity of the surface of the paper sheet
Measured as the volume of air which, at a specified pressure, passes per time unit between the surface of the paper and a flat ring



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SURFACE ROUGHNESS - SMOOTHNESS

- Units:

- Bendtsen: Bendtsen roughness number (ml of air escaping per minute)
- Bekk: seconds.
- Parker Print Surf (PPS): µm

- Recommendation: For newsprint:

Bendsten 98 kPa: Between 75 and 175 ml/min

Bekk: between 45 and 75 s (75s corresponds to high-filler content grades or super-calendered grades)

PPS (10Mpa): between 3.0 and 4.6 µm

- Determination:

ISO 2494 (Bendtsen)

PPS widely used

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SURFACE ROUGHNESS - SMOOTHNESS

Depends on humidity.
For the measurement, samples should be taken from reel stubs immediately after they are removed from the press.

Smoothness is one of the most important properties affecting printability.

Better smoothness:
- better printability
- but ink penetration into the paper decreases (set-off & rub-off)

Rougher paper:
- more ink consumption
- more print-through

--> There is a compromise to be found

On single-wire paper machines, more "two-sidedness" of the paper --> differences in smoothness between the two sides of the paper.

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COMPRESSIBILITY

- **Definition:** Extent to which the sheet thickness is compressed when a pressure is applied to the surface of the sheet.

- **Units:** Dimensionless quantity
  Expressed in %

- **Recommendation:** No

- **Determination:** No standard

In general:

- A sheet with high smoothness will have low compressibility
- Mechanical pulp is more compressible than chemical pulp (for a given smoothness).

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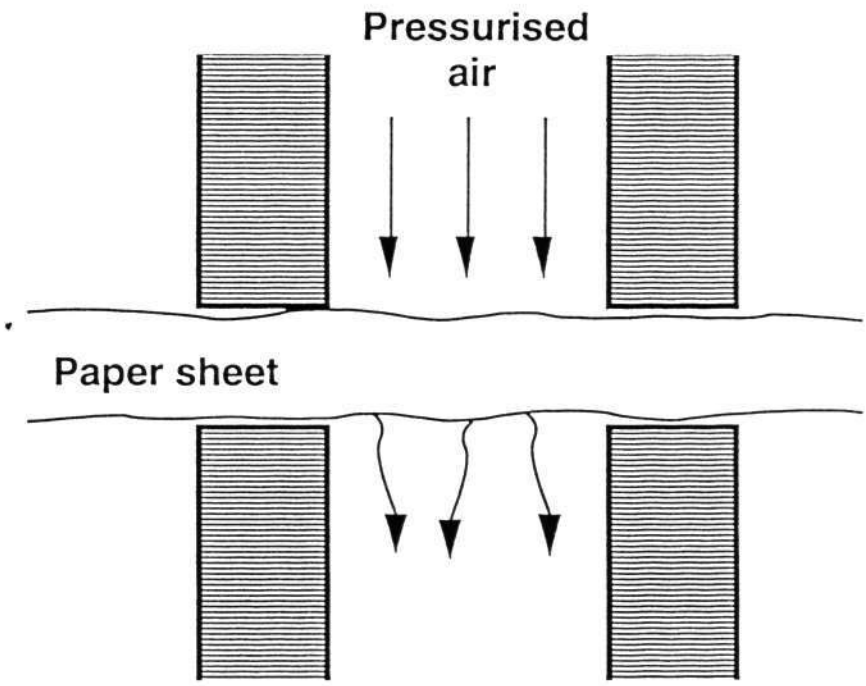
POROSITY - AIR PERMEABILITY

- Definition: Combined volume of pores, capillaries and other voids between the fibres

Not directly measurable. Air permeability: flow rate of air through a specified surface area of the paper with a constant and specified pressure difference between the two sides of the sheet.



- Units: m/Pa.s. Preferred: µm/Pa.s

$$S(m/Pa.s) = \frac{u(m3/s)}{A(m2) \cdot \Delta P(Pa)}$$

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POROSITY - AIR PERMEABILITY

- **Recommendation:** No

- **Determination:** Bendtsen, Bekk or PPS devices fitted with special accessories.

In general:

- Poor correlation with print result
- However, variations should be kept to a minimum during manufacture.

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OIL ABSORPTION / WATER ABSORPTION

- **Definition:** Amount of liquid absorbed by a piece of paper of a given surface within a given time.

- **Units:** SI units: kg/m2
  Preferred units: g/m3

- **Determination:**
  Cobb-Unger testing instrument

- **Recommendation:**
  No general recommendation

- **Remark:**
  Oil absorption simulates the paper behaviour with **ink**
  Water absorption simulates **damping solution**
  But:
  - measurement not easy
  - correlation with printing difficult

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Basics of papermaking

SHEET FORMATION

- One of the basic characteristics

- Can be checked visually by transmitted light --> appearance of light and dark areas.

- On the wet part of the paper machine, fibres tend to cling together to form flocculations. The purpose of the headbox is to break these flocculations.

Bad formation may be compensated by a good compressibility

- Wire marking: depends on the type of wire. Can have a visual effect on printed solids and halftones.

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ISO-BRIGHTNESS

- Definition: Diffuse blue reflectance factor. Ability of the newsprint to reflect diffuse light in the blue region of the visible light spectrum.
Ratio of light reflected by a pad of newsprint (thick enough to be totally opaque) to the light reflected by a perfect reflecting diffuser, under the same conditions, both reflected lights being measured at an effective wavelength of 457nm.

- Units: Dimensionless. Expressed in %

- Recommendation:
ISO-brightness gives a good indication on the brightness of the furnish from which the newsprint was manufactured. But, it is not a good description of the shade of the paper. No general recommendation can be given.

- Determination:

ISO 2470
ISO 2469 (for the calibration of the reference instrument)

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How to improve brightness?

- **Purification:** physical or chemical removal of non-cellulosic materials which can cause light absorption.

- **Bleaching:** decolouration by oxidation.

- **Fillers:** high-brightness fillers can be used. The role of filler is to improve opacity.

- **Fluorescent dyes:** counteract the yellowing of lignin by boosting blue reflectance.

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NEWSPRINT SHADE *(Y-value / Dominant wavelength / Excitation purity)*

- Definition: Shade is an attribute of the visual perception of colour
It is characterised by three parameters:

- Y-value: lightness of the sheet. Ratio of C-light reflected by a pad of newsprint to the light reflected by a perfect diffuser (2° observation angle).
- Dominant wavelength: wavelength of the monochromatic component of the colour mixture which matches the evaluated shade of newsprint.
- Excitation purity: Proportion of the monochromatic component which matches the evaluated shade of newsprint.

- Units:

- Both Y-value and excitation purity are dimensionless and expressed in %
- Dominant wavelength is expressed in nanometers (nm)

1 nm = 10^{-9} m = 0.000000001 m

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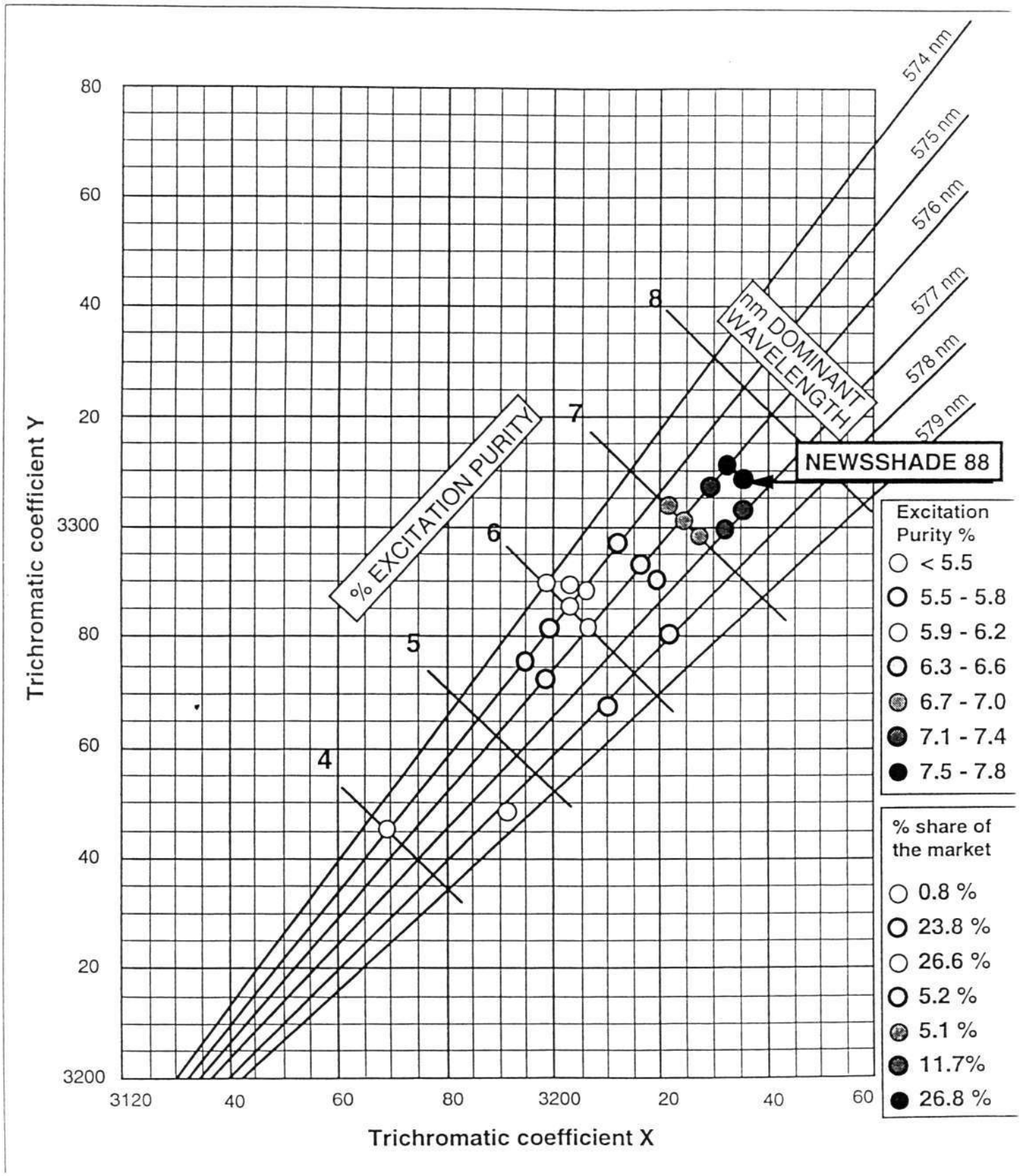
Newsshade 95

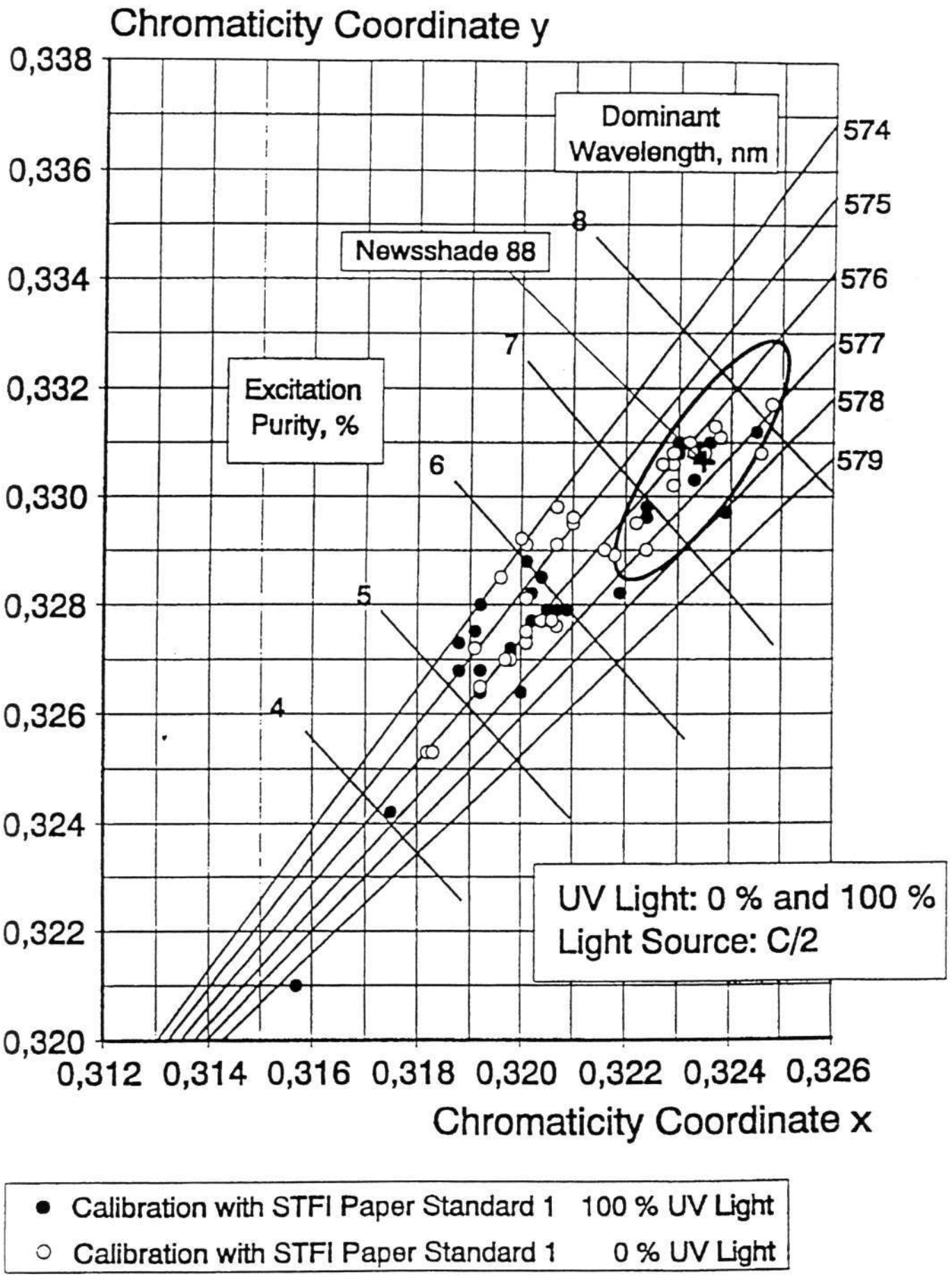
Helmholtz coefficients		L*a*b* values	
Y-value	63,5	L*	83,7
Dom. Wavelength , nm	576,5	a*	-0,29
Excitation Purity pe, %	5,5	b*	5,05
Instrument Calibration	according to ISO 2469		
UV-Share	0 % UV (with 395 nm -UV-filter)		
Geometry	d/ 0		
Backing	Newsprint		
Production Tolerance	$\Delta E < 0.7$		

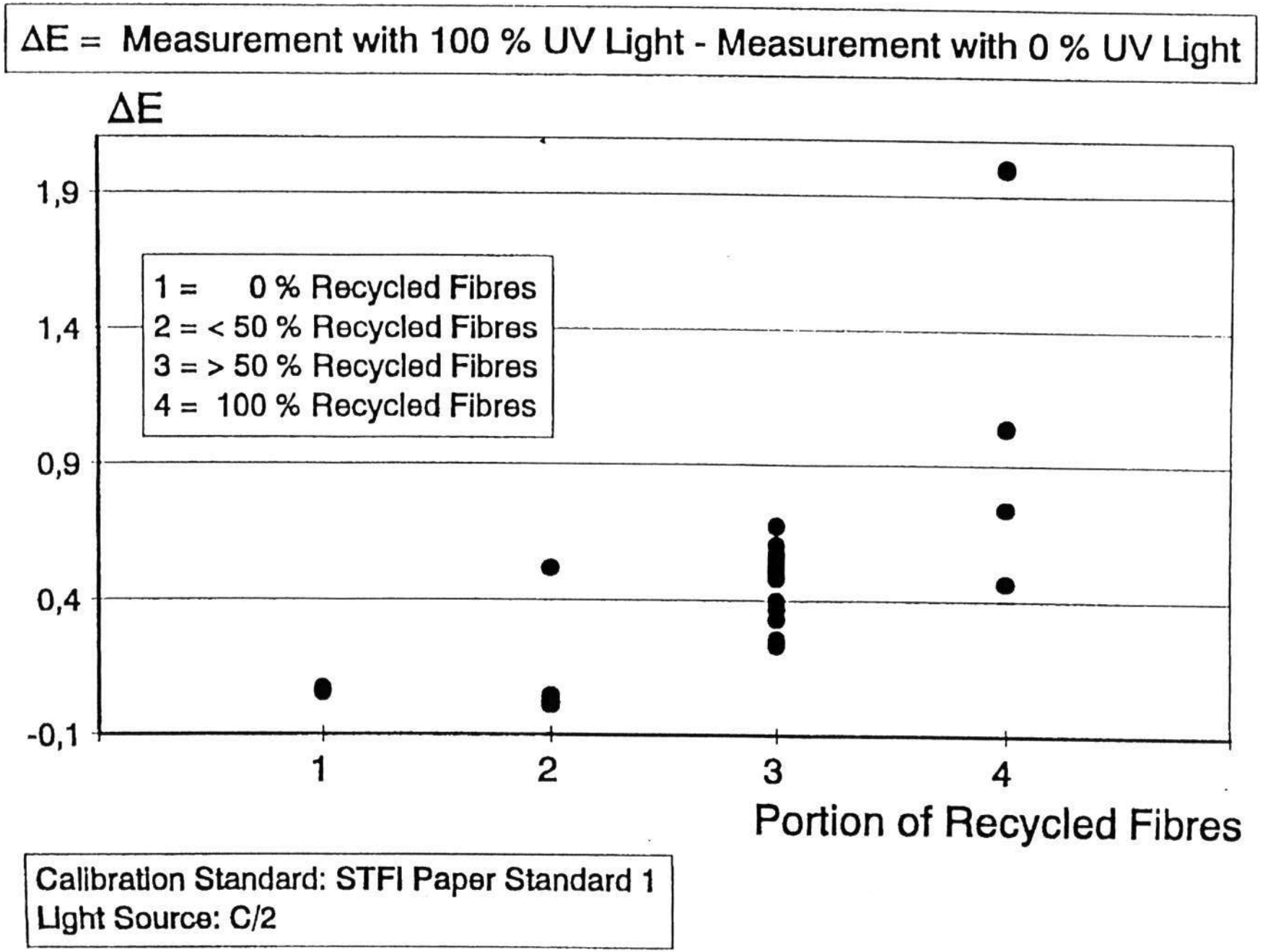
Table 12: Target values for Newsshade 95 with C/2

		L*a*b* values	
Y-value	63,5	L*	83,7
Dom. Wavelength , nm	578,5	a*	0,61
Excitation Purity pe, %	6,4	b*	5,08
Instrument Calibration	according to ISO 2469		
UV-Share	UV -Share of D50		
Geometry	d/ 0		
Backing	Newsprint		
Production Tolerance	$\Delta E < 0.7$		

Table 13: Target values for Newsshade 95 with D50/2







OPACITY

- Definition: Ability of the sheet not to transmit light. Ratio between the luminous reflectance factor of a single sheet with a black background and the Y-value, both measured through a green filter with an effective wavelength of 557 nm.

- Units: Dimensionless. Expressed in %

- Recommendation:

For the printer, opacity should be at its highest possible level (no show-through)
With normal conditions (Y-value=64.5%):

Grammage (g/m2)	Opacity (%)
48.8	93.5
45	92
40	90

- Determination:

ISO 2471
ISO 2469 (for the calibration of the reference instrument)

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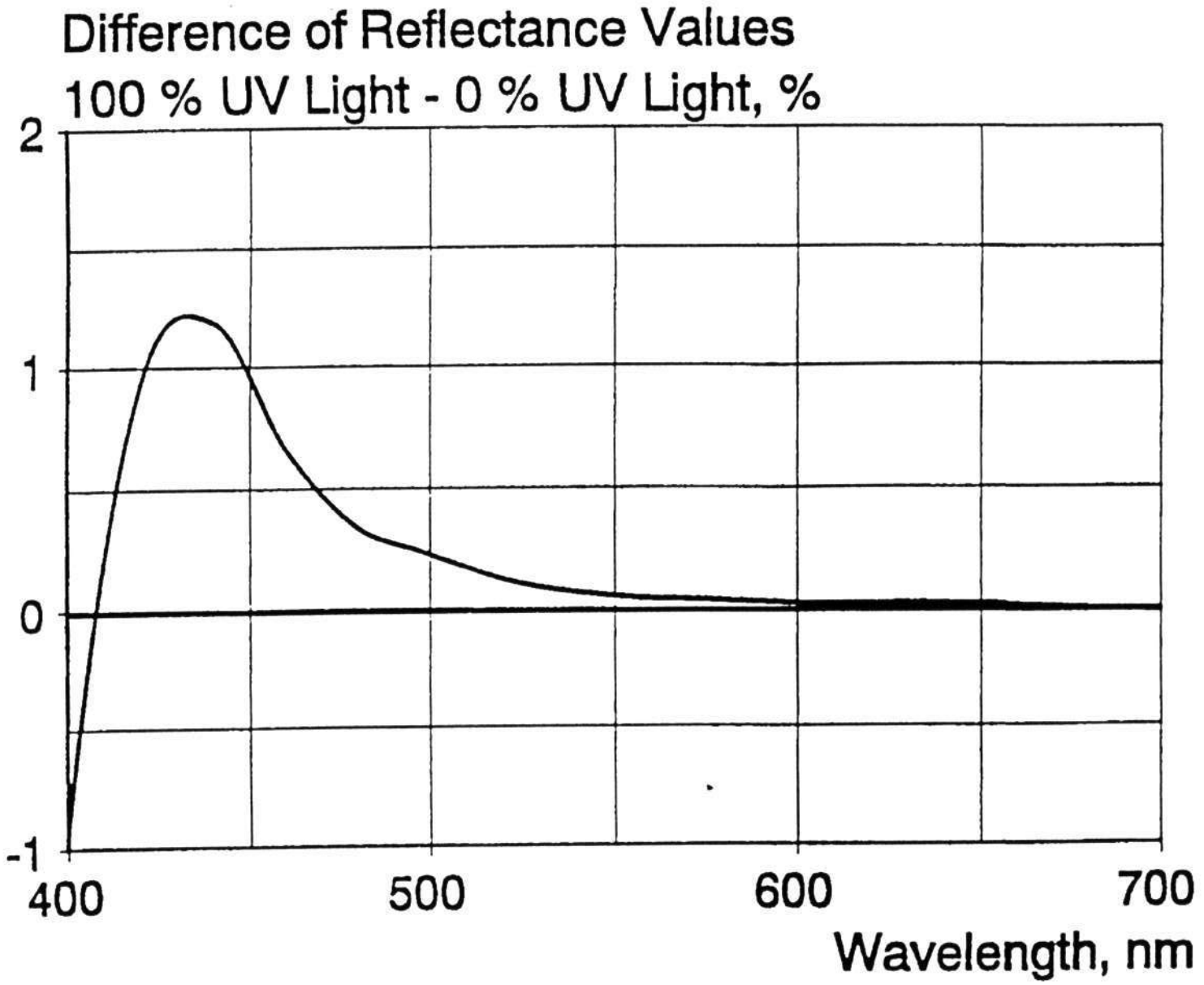
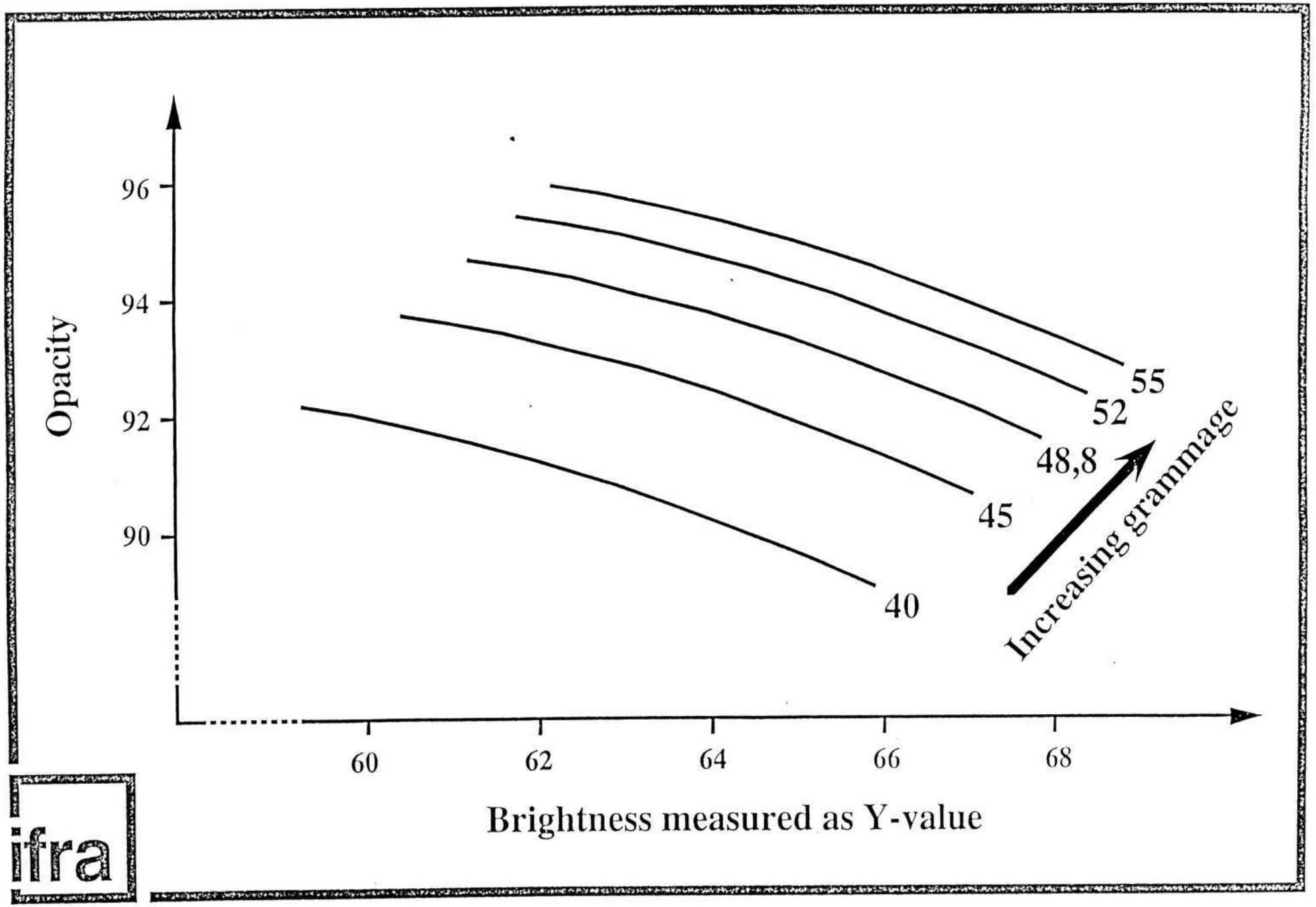
Newsprint sample made of 100% recycled pulp





MECHANICAL CHARACTERISTICS

- Important for the **runnability** at the press. But: does not correlate perfectly.

- Mechanical strength of a sheet:
  depends on:
    - strength and orientation of the individual fibres
    - strength of the bonds between fibres

  which depends on:
    - furnish of the newsprint
    - processing conditions of the pulp
    - manufacturing conditions at the paper machine

There is a **compromise**: a better paper needs a better furnish and better manufacturing conditions

--> That costs money !!

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TENSILE STRENGTH & ELONGATION

- Definition:

Tensile strength: maximum tensile force per unit width that a test piece of paper can stand before breaking

Elongation: ratio of the increase in length of a test piece submitted to the max. tensile force to its length before the test.

- Units: Tensile strength: kN/m
Elongation: %

- Recommendation: No

- Determination: ISO 1924

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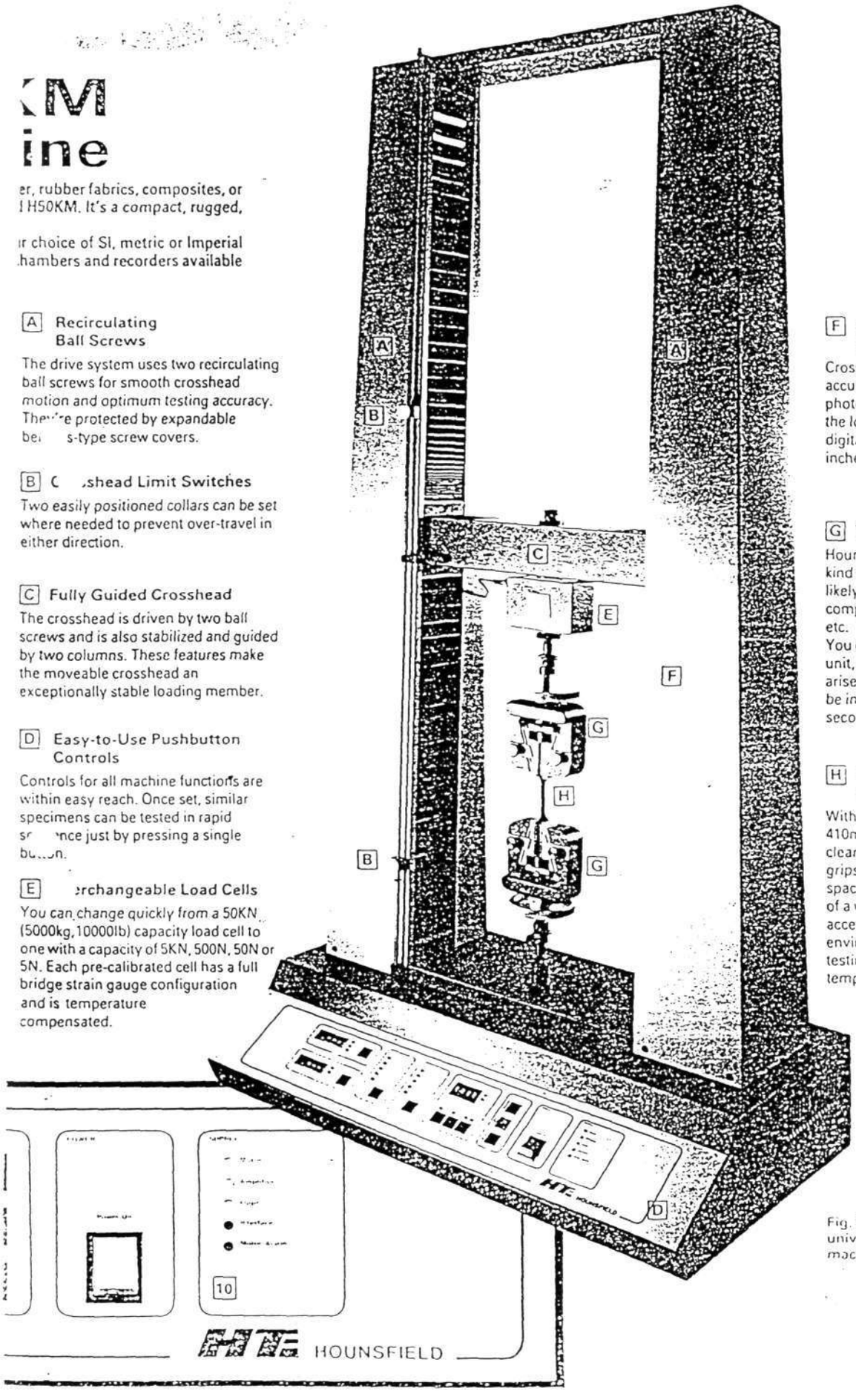
KM
ine

er, rubber fabrics, composites, or
l H50KM. It's a compact, rugged,

ır choice of SI, metric or Imperial
.hambers and recorders available



A Recirculating Ball Screws

The drive system uses two recirculating ball screws for smooth crosshead motion and optimum testing accuracy. They're protected by expandable bellows-type screw covers.

B Crosshead Limit Switches

Two easily positioned collars can be set where needed to prevent over-travel in either direction.

C Fully Guided Crosshead

The crosshead is driven by two ball screws and is also stabilized and guided by two columns. These features make the moveable crosshead an exceptionally stable loading member.

D Easy-to-Use Pushbutton Controls

Controls for all machine functions are within easy reach. Once set, similar specimens can be tested in rapid sequence just by pressing a single button.

E Interchangeable Load Cells

You can change quickly from a 50KN (5000kg, 10000lb) capacity load cell to one with a capacity of 5KN, 500N, 50N or 5N. Each pre-calibrated cell has a full bridge strain gauge configuration and is temperature compensated.

F Precise Extension Measurement

Crosshead motion is accurately measured by a photo-optical encoder within the load frame and shown digitally in millimetres or inches.

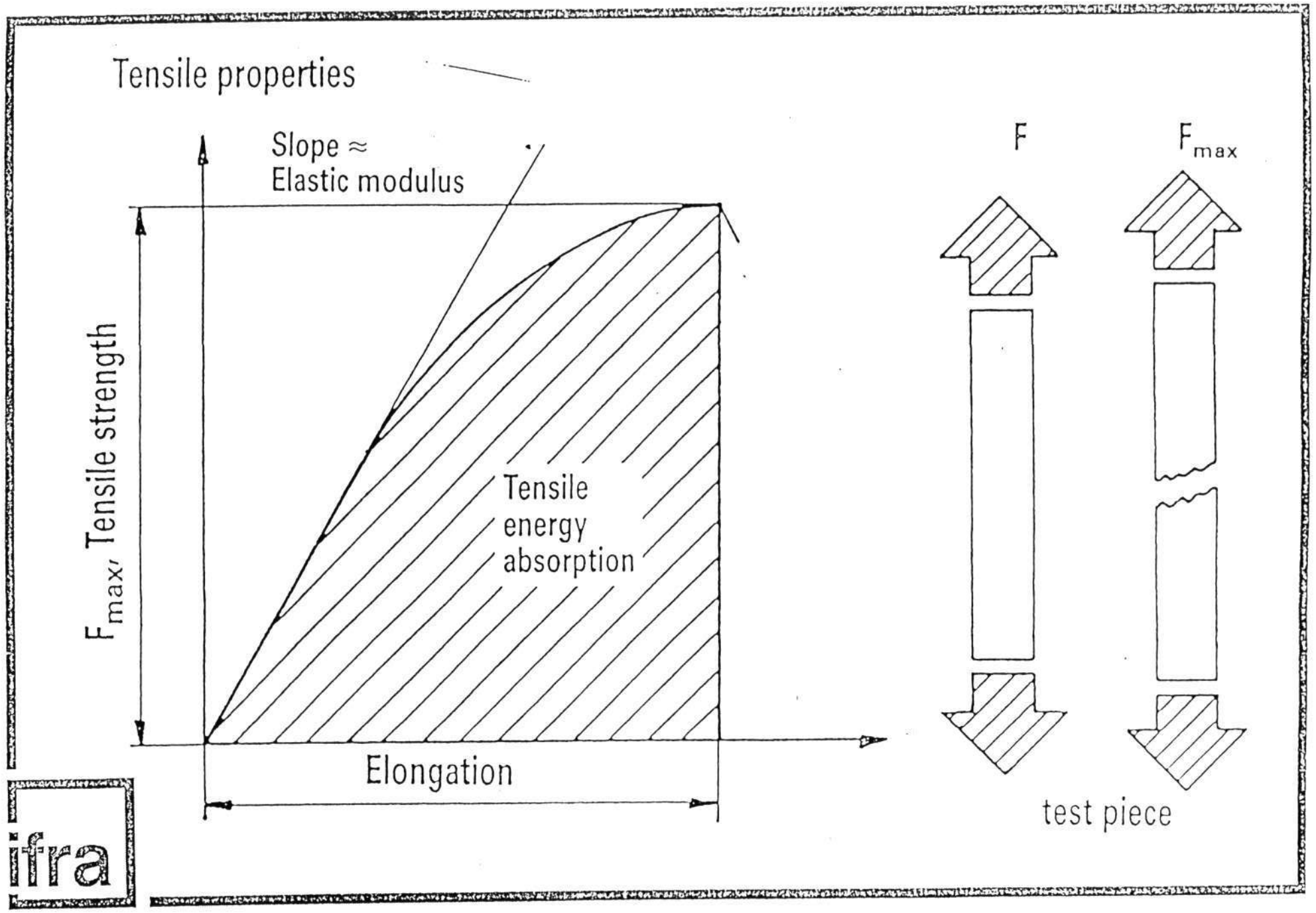
G Testing Tools

Hounsfield offers almost any kind of testing tool you're likely to need for tension, compression flexure, shear, etc.
You can order them with the unit, or add them as the need arises. Most grips or tools can be installed in a matter of seconds.

H Large Testing Clearance

With a horizontal clearance of 410mm and a vertical clearance of 1100mm less grips the H50KM has ample space for accommodating any of a wide range of tools or accessories, including environmental chambers for testing at non-ambient temperatures.

Fig. 3 Rugged bench-top universal testing machine



TEARING RESISTANCE

- **Definition:** Mean force required to continue the tearing on an initial cut in a single sheet of paper.
Two different values:
  - machine direction (MD)
  - cross direction (CD)

- **Units:** SI: mN
  Tear index in Nm2/kg

- **Recommendation:** No

- **Determination:**
  ISO 1974 (Elmendorf device)
  Other possibilities (Ex: Brecht-Imset)

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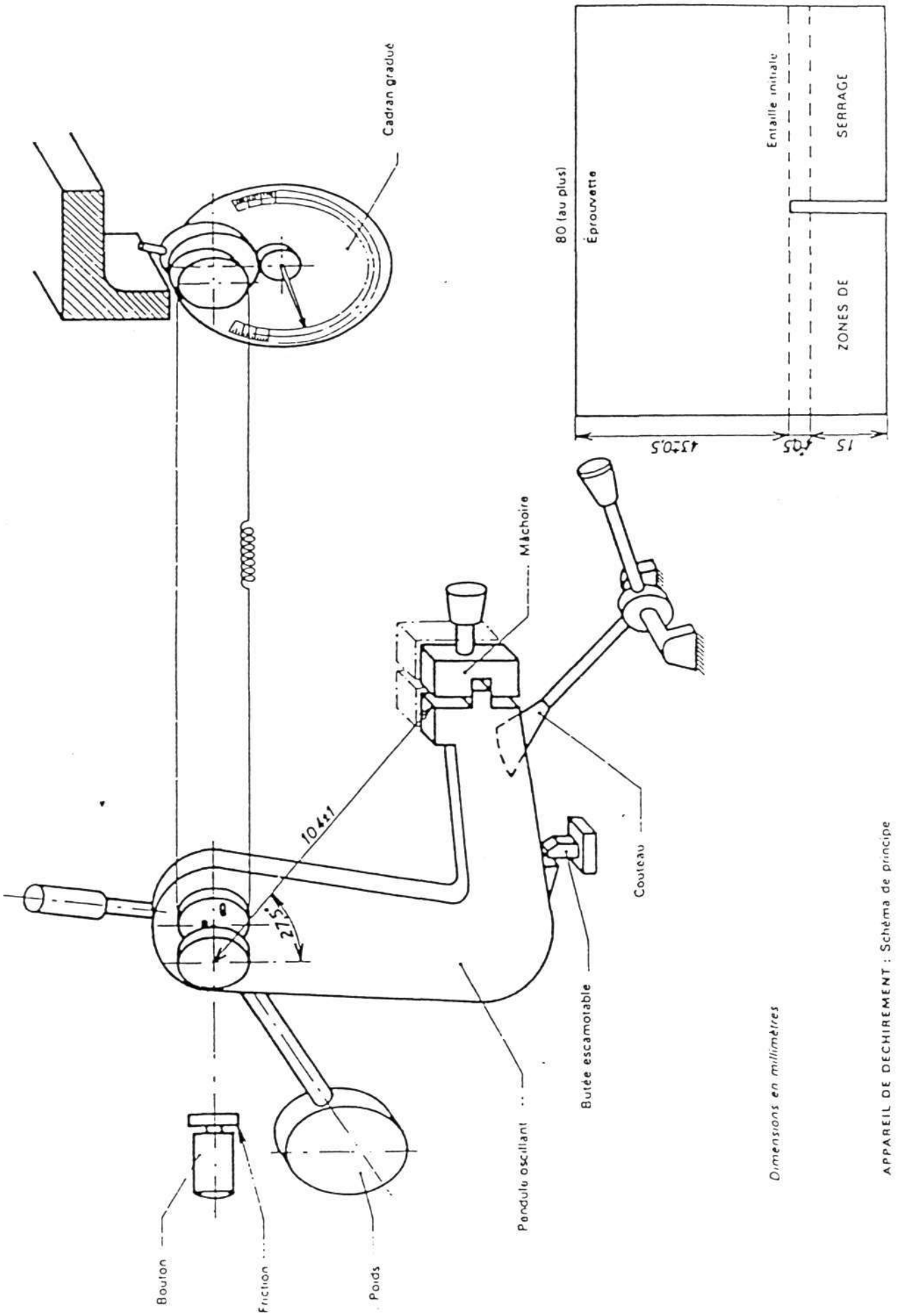

Dimensions en millimètres

APPAREIL DE DECHIREMENT : Schéma de principe

NEWSPRINT QUALITY CONTROL

WHY QUALITY CONTROL?

1. Heterogeneous nature of paper
2. Methods used to measure properties
3. Variations in quality requirements from user to user

Four major areas:

- Establishing **purchasing specifications** to be met by newsprint suppliers
- Realistic **control** of consignments
- As **day-to-day service support**:
  - use certain consignments for certain jobs
  - reject some consignments
- **Troubleshooting and complaints** are only possible with a well-established quality control programme.

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NEWSPRINT QUALITY CONTROL

ISO 9000

- Series of standards developed by the "International Organisation for standardisation"

- Define the requirements for an in-plant quality assurance.

- With ISO 9000, it is not the product quality that is defined but the capacity of a business to produce quality.

- Five part standards: ISO 9000-9001-9002-9003-9004

- See IFRA Special Report 6.11: The ISO 9000 certificate, encouragement and guarantee for a continually effective quality control system

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NEWSPRINT QUALITY CONTROL

HOW TO ESTABLISH A QUALITY CONTROL PROGRAMME?

Each printing plant is an individual case: different printed products, different printing processes, different paper consumptions and different quality levels

Each printer must start from scratch and search for relations between newsprint properties and press performance / print quality.

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NEWSPRINT QUALITY CONTROL

ESTABLISHING PURCHASING SPECIFICATIONS

3 following stages:

- an educational period:

- best tools for the printers: his senses (**eyes** to check the shade of paper, colour matches, print densities / **fingers** to test the smoothness of the paper, bulk of the sheet, hardness of a reel, rub-off tendency of a print).
- From that, correlate to measuring methods

- qualitative calibration period:

- influence of paper quality on print quality and press performance
- have to be taken into account: effect of inks, plates, blankets, press and print conditions
- Start systematic evaluation of newsprint deliveries by a representative sampling procedure

- quantitative evaluation of quality requirements:

For each property: min., max. and optimum values

- variations between deliveries and within a delivery
- the tolerances can be used as purchasing specifications

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NEWSPRINT SPECIFICATION
(Newcastle Chronicle & Journal)

Test	Value
Grammage: (BS 3432 : 1985)	Nominal ± 0.5%
Thickness: (BS3983 : 1989)	75 microns ±5
Moisture content (BS 3433 1986)	8.0 ± 0.5%
Machine direction Tensile strength (BS 4415 : 1985)	30N/15mm minimum
Machine direction Stretch %	1.1± 0.1
Stretch ratio Cross direction/machine direction	2.5 maximum
Set-off index (Pira method: instantaneous)*	35 maximum
Print Penetration (IGT method)* W24	17-20
Tear strength (BS 4468 : 1990) Cross direction	250 min
Brightness % (BS 4432 Pt 2 : 1980)	59 minimum
Opacity % (BS 4432 Pt 3 : 1980) for 48.8 gsm :	94
for 45 gsm :	93
Colour measurements	
Y value %	63.5 minimum
Dominant Wavelength	576 ± 2
Excitation purity %	5.5 ± 0.5
Bendsten Porosity ml/min (BS 4420: 1990)	250 ±100
Printsurf roughness (µm) (BS 6563: 1985)	
at 1000 kPa	3-4
at 2000 kPa	2.5-3.5
Reel hardness profile	40 ± 5
(Schmidt Hammer Test	Less than 10

Note : Set-off index: see test method appended

CONTROL OF DELIVERIES

Purchasing specifications have been established.

It is better to have:

- low quality but consistent

than

- high quality with a lot of variations

Important: variations in cross direction should be checked.

First step: check the usable amount of paper. If damages during transport: contact suppliers, transporters or insurance companies.

Second step: check average grammage of each consignment. The tolerances should be agreed with the supplier.

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DAY-TO-DAY SERVICE SUPPORT

When receiving a new consignment: some reels should be chosen **randomly** and run on the press. Afterwards, paper samples could be taken on the reel stubs for evaluation.

Three possible options:

1. good delivery, uniform in quality and consistent with previous ones
   --> should be no problem on the press

2. delivery within the specified tolerances but with variations with previous deliveries
   --> pressroom should be notified

3. delivery outside specifications
   --> potential cause of quality or production troubles. (see troubleshooting and complaints)

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DAY-TO-DAY SERVICE SUPPORT

However, if a delivery is considered as good, some problems can still arise:
- local sheet defects possible
- a laboratory evaluation does not simulate completely press performance.

If there are defective reels (out-of-roundness, uneven hardness)
--> use them for a "quiet" working day (lower pagination or black&white works)

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HOW TO ESTABLISH A QUALITY CONTROL PROGRAMME

TROUBLESHOOTING & COMPLAINTS

Newsprint properties are relative:
--> you need a reference point.

A printer who does not check his deliveries is helpless when problems arise

To be efficient a quality control programme should involve a **continuous measurement of the properties** of newsprint deliveries with a **well-thought statistical procedure**.

Then, productivity and quality problems can be related to paper properties.

When a problem arises, there can be a dialogue between the printer and the papermaker.

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WHICH PROPERTIES TO TEST?

Different printers have different points of view. They may want to:

- reach a certain print quality level.
- reach a certain runnability level in the press.
- reach a certain runnability level for the copies in the mailroom
- only check the delivered newsprint quantities.

The following properties are evaluated according to their influence on:

- printability
- linting
- runnability
- economic aspects --> **most important: all described problems will have an influence.**

Different rates can be given at the end: no influence, low, medium and high influence. (see table).

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WHICH PROPERTIES TO TEST?

PRINTABILITY ASPECTS

Print uniformity: (solid & halftone areas)

- uneven distribution of fibres
- low compressibility
- linting (too low surface strength)

Relative print density:

- depends on the Y-value. The more luminous, the smaller the ink requirement to achieve a certain print density.
- paper too rough

Ink setting:

- paper too smooth: less ink absorption, set-off.

Print-through= Show-thr. + Strike-thr.

Show-through: opacity

Strike through: penetration (pigments particles normally stay at the surface)

Colour rendering: influenced by shade variations.

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WHICH PROPERTIES TO TEST?

LINTING

Definition: loosening of fibre particles in the printing nip during ink splitting

blankets --> plates --> ink rollers --> ink fountains

When build-up on blankets affect print quality: press has to be stopped for wash-up.

Some methods to test surface strength.

Plugging: term used in letterpress - mix of fibres and ink in the voids between the dots in highlight areas.

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WHICH PROPERTIES TO TEST?

RUNNABILITY ASPECTS

Web breaks: paper-related causes:

- too low moisture content
- sheet defects
- winding or splicing defects at the mill
- wrapping defects (Ex: glue on reel ends)

Web stability:

(MD and CD register accuracy)

- variations in elasticity modulus: different reactions to web tension
- variations due to damping application
- variations in winding tension
- core defects

Web tension control:

- cross direction non-uniformity.

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