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Version 4

**Statistics applied
to corrugated board****■ Measurements and average values**

The paper, board and packaging test standards require, depending on characteristics, 5 to 20 measurements.

Since the individual measurement is not meaningful, we should use the average of the measurements. Only this can be compared to the agreed value.

It can therefore be stated that:

- The average characterises the batch.
- It can be estimated with few measurements.
- Irregular quality of a batch will result in an average that is generally lower.

■ Sampling

Refer to the minimum quantities specified in the test standards or to smaller quantities agreed between the parties.

Presentation of results:

- Average = $\frac{\text{sum of the measurements}}{\text{number of measurements}}$

- Coefficient of variation (%) = 100 x standard deviation/average, this is the standard deviation expressed as a percentage of the average with the standard deviation equal to:

$$\sqrt{\frac{\sum_{i=1}^N (x_i - \bar{x})^2}{N - 1}}$$

where x_i = individual measurement

and \bar{x} = average

Most of the characteristics of the corrugated board have quite a large coefficient of variation of measurements, at least 5%.

■ Destructive or non-destructive tests

The measurements of physical or mechanical properties are generally destructive.

Destructive tests are costly in terms of materials and manpower.

Non-destructive measurements generally relate to geometric properties and appearance.

■ Tolerances

These must be set taking into account the expected functionalities of the packaging and the accuracy of the normal production technology.

They can be covered by a contractual agreement.

■ Conformity criteria

The conformity of a batch is assessed by comparison of the measured average to the usual or contractual requirement..

Examples of properties:

Bursting, ECT, FCT, BCT: Measured average greater than or equal to the agreed value.

- Note about BCT (Box Compression Resistance) :

According to a study carried out by 5 ONDEF member companies, a sufficient knowledge of BCT is obtained from between 3 to 10 measurements (less than 2% deviation relative to the average of 100 measurements).

Dimensions:

The professional Code of Practice and Information Sheets no. 11 and no. 12 recommend:

For **single wall** and **double wall**:

If $L+B+H \leq 1\ 500$ mm then agreed nominal value ± 3 mm tolerance for each dimension.

If $L+B+H > 1\ 500$ mm then agreed nominal value ± 5 mm tolerance for each dimension.

For **triple wall**:

Agreed nominal value ± 5 mm tolerance for each dimension.

