

# *Determination of the water resistance of the glue bond of corrugated fibreboard by immersion*

## **1 Scope**

To define the apparatus and test procedure used to determine the water resistance of the glue lines of corrugated board. This method is applicable to all types of corrugated board for which a high degree of bond strength is required to resist the influence of wet conditions.

## **2 References**

FEFCO testing method n° 1 : sampling procedure

EN 20 187 : paper, board and pulps - Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.

## **3 Principle**

The water resistance of the glue of corrugated fibreboard is expressed by the length of time during which a predetermined combination of glue lines, immersed in water, resists the pull of a suspended weight in the plane vertical axis of the board, at a right angle to the glue lines.

## **4 Apparatus**

**4.1.** A water tank, preferably glass, for easy observation, large enough for the free suspension of the required number of test specimens. The depth of the tank shall be at least 25 cm. The bottom of a glass tank may be lined with a rubber sheet to prevent damage.

**4.2.** A number of rods or bars with hooks. These to be placed across the tank for suspension of the test specimens. Means for proper identification of test specimens shall be provided.

**4.3.** A soft rubber stamp to mark the sample corrugated board with outlines and other details for cutting the test specimens. The design to be imprinted on the corrugated board is shown in fig.1.

**4.4.** A knife with a sharp, thin blade.

**4.5.** A straight edge.

**4.6.** Punch pliers.

**4.7.** Eyelet pliers, and eyelets.

**4.8.** A 250 g copper weight for each test specimen. Each of these weights shall be provided with a hook.

**4.9.** A time control device.

## **5 Sampling**

Sample in accordance with FEFCO Testing Method N° 1.

## **6 Conditioning**

The samples shall be conditioned in accordance with EN 20 187 (i.e.  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ,  $50\% \pm 2\%$  r.h.).

## **7 Preparation of test pieces**

### **7.1. Sample**

Individual samples must be large enough to permit the cutting of test pieces, size  $20\text{ mm} \pm 1\text{ mm}$  by  $150\text{ mm}$  approximately, with the flutes at right angles to the length of the specimen. Except for routine production control tests, the corrugated board to be tested should generally be at least three days old to allow it to develop its water resistance properties. The time will be dependent on temperature and adhesive formulation.

### **7.2. Test specimens**

The test specimens shall be conditioned in accordance with EN 20 187 (i.e.  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ,  $50\% \pm 2\%$  r.h.).

To guide the operator in preparing the test pieces, the corrugated board sample will be marked by means of the rubber stamp (clause 4.3.).

The specimens to be tested are picked at least 50 mm away from a crease, edges and finger lines and also from small local defects in the paper. Not more than one specimen should be cut out of an area approx.  $1/2\text{m}^2$ .

Unless otherwise specified test pieces have to be free from all irregularities or damage, especially by water, mechanical stress (e.g. finger lines).

Two holes shall be punched into the pieces, their centres being at a distance of 10 mm from either end and side, respectively.

Eyelets are inserted into these holes and clenched.

Alternatively a suitable clamp may be used to suspend the test specimen from the rod. A cooper clamp may be used at the lower end to suspend the weight. This clamp and any additional copper weight shall not exceed a total of 250 g.

### 7.3. Determination of the glue lines to be tested

The shearing stress is concentrated on five lines to be tested within zone M (see fig. 1). These glue lines shall be isolated by cuts through the components as may be necessary to achieve this object, as exemplified in fig. 2 for single wall, fig. 3 for double wall board.

## 8 Procedure

Five test pieces of each set of glue lines to be tested (standard number), with their ends loaded with weight (see 4.8), are suspended in the tank, which be filled with neutral water (distilled, deionized, demineralized, hydrant) that all M zones (clause 7.3.) of the specimens remain immersed 25 mm below the surface of the water throughout the test period. Care should be taken to avoid the inclusion of air bubbles in the flutes.

Individual test pieces will not be used to test more than one set of five glue lines between the selected lines and its fluting.

### 8.1. Test temperature

The temperature of the water shall be  $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

### 8.2. Timing

The immersed specimens will be checked for failure at 24 hour or such shorter intervals as may be suitable. An automatic time control device is recommendable.

### 8.3. Failure

Failure of a specimen is shown by complete separation of the five bonds on the same liner side, which will cause the weight to drop.

## 9 Test report

The test report will contain the following details :

- a) *Date and place of testing*
- b) *Description and identification of the product tested*
- c) *Identification of each specimen tested*
- d) *Number of specimens tested and number of failures at each set glue lines at the chosen test intervals. State intervals.*
- e) *Statement whether after rupture :*
  - \* *fibres adhere to the glue*
  - \* *glue predominates on the fibre surface.*
- f) *Details of any deviation from this testing method*
- g) *Any other information which may assist in the interpretation of the test results.*

## 10 Interpretation of the test results

The board can be considered as « water resistant » :

- *if for every test specimen the time of resistance is at least 24 hours without a dropped weight (standard : 5 test pieces of each cutting type).*
- *should there be one early failure per sample type within a period of 24 hours under load, the test will have to be repeated with the corresponding sample type with the full number of specimens (standard : 5 test pieces).*

In this case the test will also be considered as successful, if in the repeated test all specimens remain resistant for at least 24 hours.

- *in all other cases (more than one early failure per sample below 24 hours in the first test round, as well as one more early failure in the repeated testing), then the test will be considered as not successful.*

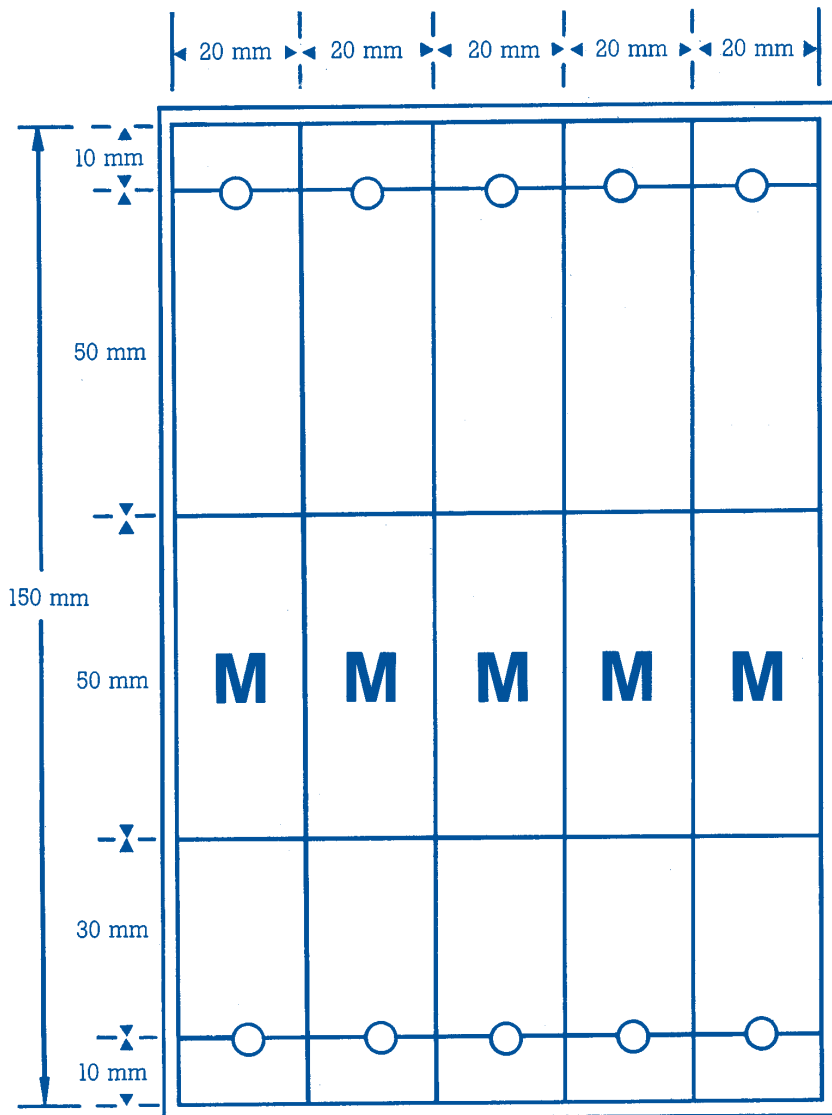
Sporadic weak spots in the paper being technically unavoidable, are not taken into consideration in respect to moisture-proof bonding. (Sporadic impurities do not influence the acceptance but systematical ones in the paper may be a reason for rejection).

## 11 Notes

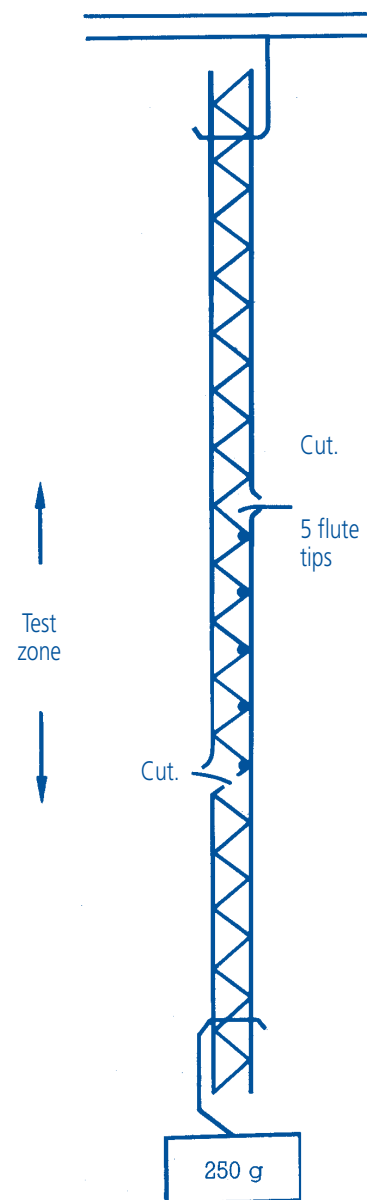
**Water resistance of the manufacturer's joint of a box.** (Only valid for joints, made with an adhesive or taping band, which can be reactivated with water).

This is also a very good method to test the water resistance of the manufacturer's joint of a box. In this case 2 cm wide strip cuts across the manufacturer's joint are tested according the prescribed method for ordinary board specimens. The whole glued zone has to remain under water. The evaluation of test results has to be done as described in clause 10.

**Diagrams**



*Fig.1  
Rubber stamp*



*Fig.2  
Diagram showing suspension  
arrangement and typical cuts  
in s.w. board*

Diagrams showing typical cuts in D.W.  
board to isolate the five glue lines, to be tested

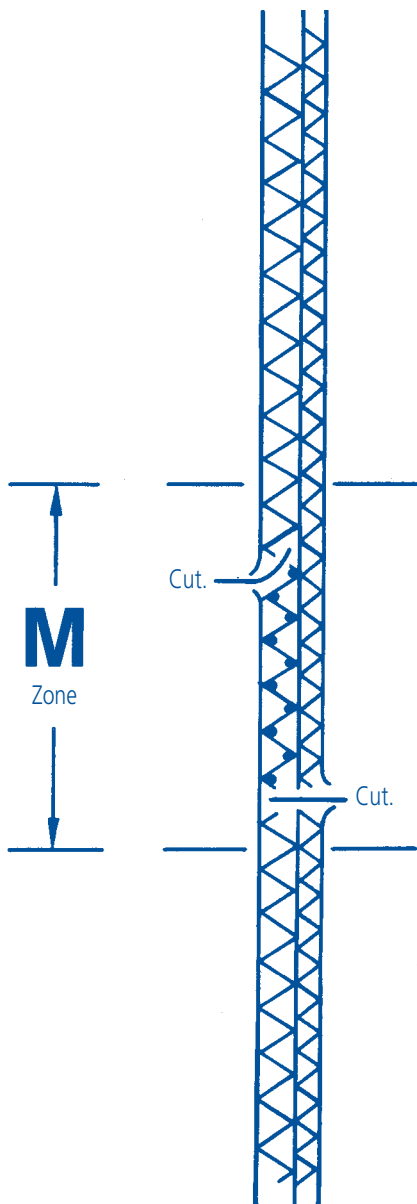


Fig. 3  
"A" "A"  
flute/liner flute/centre

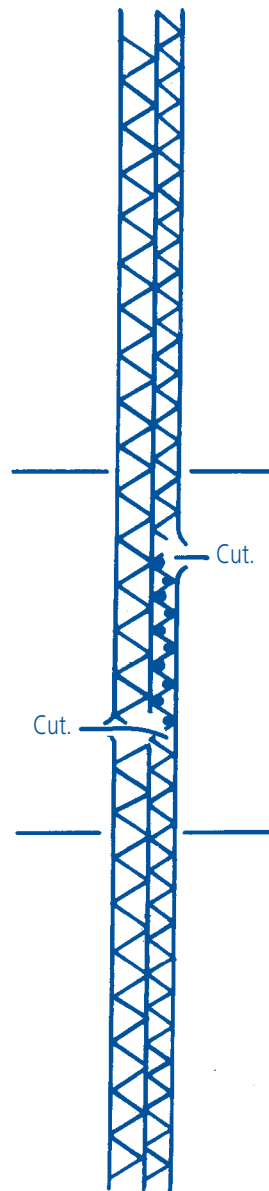


Fig. 4  
"B" "B"  
flute/liner flute/centre