EMPHA
European Manufacturers Paper Honeycomb Association

Voluntary Technical Standard

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Paper Honeycomb Determination of Compression Strength

DISCLAIMER

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Foreword

EMPHA is the European Manufacturers Paper Honeycomb Association, with headquarters located at The Hague, The Netherlands.

Within EMPHA organization, a Technical Task Team has been created to address the issue of Voluntary Technical Standards. The goal for this committee is to create a set of technical standards and methods that can be used, on a voluntary basis, to create and maintain transparent and measurable parameters that define the specific quality of the paper honeycomb.

The Standard for the determination of the Compression Strength has been approved by the members of the EMPHA in the General Assembly of June 2012.

Introduction

Paper Honeycomb is frequently used to withstand compressive pressure perpendicularly to expanded honeycomb surface. In consequence, compression strength is an important functional characteristic of Honeycomb.

EMPHA Technical Task Team recognizes two methods of measuring the compression strength:

1. The constant speed method.
2. The static method.

As for the first method, constant speed, Technical Task Team identifies as advantages:

- the fact that it provides a clear insight on force-displacement relationship;
- it´s a method that can be calibrated and
- has similarities to compression tests used in other materials that are supported by clear defined international standards.

The second one, static method, is considered indicative.

1. Scope

This Voluntary Technical Standard specifies two different methods to determine paper Honeycomb compression strength.

Both procedures are applicable to endless and block paper honeycomb.

2. Normative references

ISO 187 - Paper, board and pulps -- Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples

ISO 3035 - Corrugated fiber board -- Determination of flat crush resistance

ISO 12048 - Packaging – Complete, filled transport packages – Compression and stacking tests using a compression tester

ISO 13820 - Paper, board and corrugated fiber board -- Description and calibration of compression-testing equipment

Related norm is:

ASTM C-365 - Flatwise compressive properties of sandwich cores.

3. Terms and Definitions

Paper Honeycomb: In the context of the EMPHA, paper honeycomb is considered as a paper product consisting of paper strips glued together in a way that forms hexagonal shaped cells when expanded.

Compression strength of Honeycomb: maximum pressure that is applied perpendicular to the nominal expanded honeycomb before collapsing measured

Unexpanded Honeycomb: compact honeycomb with no visible cells; honeycomb in a certain form, which length is similar (same order of magnitude) as the sum of individual paper sheets thickness

Expanded Honeycomb: honeycomb with visible formed cells; honeycomb in a certain form, which length is considerable superior (higher order of magnitude) to the sum of individual paper sheets thickness

Expansion rate of the Honeycomb: ratio between expanded honeycomb width and unexpanded honeycomb width

Nominal expansion: expansion rate of 75%

Collapse: point where honeycomb sheets crush due to compression damage

Isoform: The honeycomb cell is considered to be a symmetric hexagon.

4. Principle

The constant speed method: A surface (platen) is lowered on to the expanded honeycomb core with a constant speed and the resistance to this movement is measured in Newton against mm displacement.

a. Some systems work with parallel planes and in between the honeycomb
b. Some work with swiveling planes

The static method: A surface is lowered on to the expanded honeycomb and when it is in full contact without force, a force is build up to the level of failure (collapse). The surface is parallel to the bottom plate, the honeycomb is in between.

5. Apparatus

Constant speed method: a motor driven, fixed-platen or swiveling-platen type compression machine, in accordance with ISO 13820, capable of applying load through uniform movement of one or both platens.

Platen surfaces should meet the specifications described in ISO 12048.

Static method: a hydraulic or pneumatic cylinder, fixed-platen or swiveling-platen type compression machine, capable of applying load through increasing hydraulic or pneumatic pressure

In both methods, top and bottom platens must have the same dimensions.

For the reason of accuracy it is advised to take the largest platen possible to execute the testing. The area of platen is directly related to the pressing capacity of the measurement tool. When the surface is too large in combination to the type of honeycomb and the collapsing is not realized, than smaller surfaces are required.

EMPHA technical task team defines three types as recommended:

200 x 200 mm plate
150 x 150 mm plate
100 x 100 mm plate

6. Sampling

Test pieces are taken randomly from the Specimen.

The frequency is determined in relation to the needs of the supplier as well as in relation to customer requirements.

7. Conditioning

EMPHA recognizes two different alternatives for sample conditioning:

1 not dried, in accordance with ISO 187

2 Darr* dried to less than 2 % - this is considered as indicative and can be used as a certain reference level. * see appendix 1

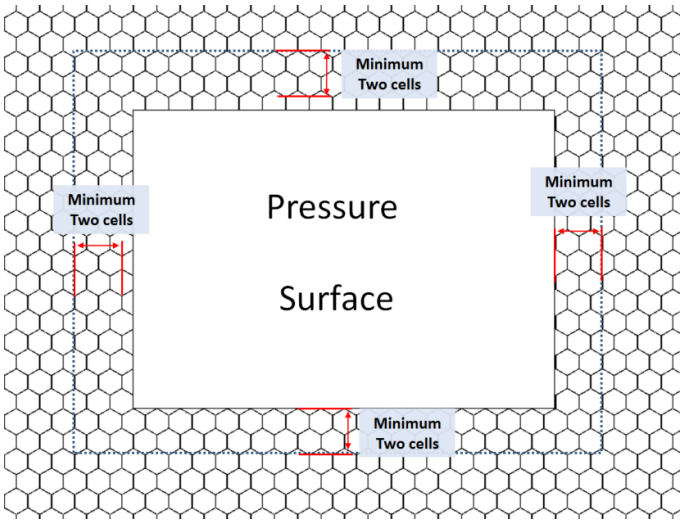
8. Preparation of test pieces

Quantity

A sufficient number of test pieces must be obtained to enable at least 5 valid tests to be made.

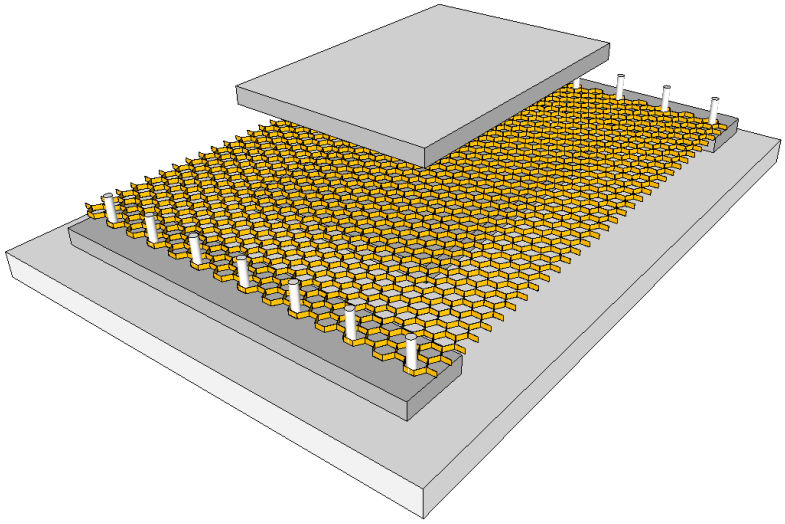
Dimensions

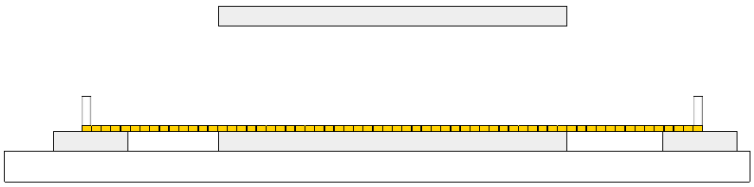
Test pieces must be large enough to guarantee iso-formity at defined expansion rate, on the area submitted to perpendicular load (pressure surface), plus two complete cells outside the platen.



Example of Pin securing

with counter surface



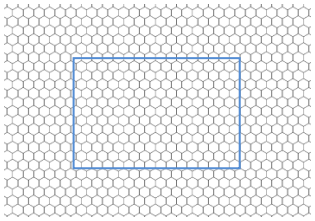
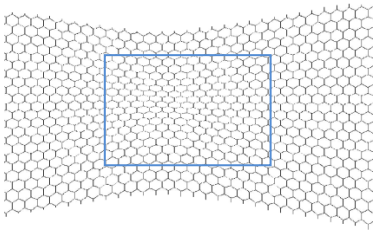
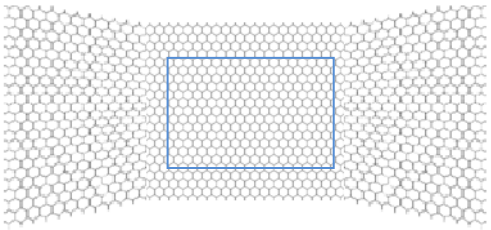


Expansion

The expansion has a serious influence on the compression strength. The compression strength test shall be performed at honeycomb nominal expansion (75%).

Form

Test piece shall have an isoform shape, at least on pressure area plus two additional cells in each direction.

Form	
Isoform	Non-isoform
	
	

9. Procedure

Test shall be carried out in the conditions in accordance to ISO 187.
Test is performed to obtain at least 5 valid results.

Select the appropriated plate dimensions from one of alternatives described in section 5, considering the measuring tool load capacity and expected honeycomb strength.

For a proper measurement, the area tested should be as large as possible, should have an isoform in expansion – according to section 8 - and should not suffer from side effects (or at least, these effects should be negligible).

In order to properly fix the test piece in position at the nominal expansion (75%), pins are be used, providing previous described conditions are met. The product support level at the pins is of the same height as the bottom platen.

Constant speed method

Place test piece on the lower platen and operated the compression tester at a constant speed of 10mm/min +/- 3mm/min (ISO 12048) until collapse occurs.

Record the maximum load sustained by test piece before collapsing.

Static method

Place test piece on the lower platen and lower the top platen to the point of full contact with test piece. Operate the machine to build up pressure until collapse occurs.

Record the maximum load sustained by test piece before collapsing.

This method is considered as indicative. The Technical Team of EMPHA did not find evidence that the results of this measurement perform a structural difference with the Constant Speed Method.

10. Expression of results

The specimen compression strength value is considered to be the average of the valid results.

Compression Strength results shall be reported in kN/m2 or kPa. This value can be obtained by dividing the maximum load by the surface area of the platen used.

Maximum pressure

$$P_{max}\ [kN/m2] = P_{max}[kPa] = \text{Load}\ [N] / \text{Area}[m2]/1000$$

11. Test report

The test report shall include the following information:

a) a reference to this Voluntary technical standard

b) the date and place of testing and the person that executed the tests

c) a description and identification of the product tested

d) the type of tester used – constant speed or static

e) dimensions of top and bottom platens

f) statement confirming that the test piece is isoform

g) statement that test piece was expanded to nominal expansion (75%)

h) test pieces conditioning – ISO 187 or Darr dried

i) results for the specimens

- mandatory
    i. Average of Compression Strength from the 5 valid results from each specimen
- optional
    i. Maximum Load
    ii. Displacement value immediately before collapsing
    iii. Deformation

Appendix 1. Darr method

The Darr-Method involves taking a sample from a building component, which in most cases has been previously obtained by drilling into the building substance using a hollow steel tube, also referred to as a core drill. The sample is then vacuum-packed, labeled so as to provide information on the name of the place where the sample was taken and the date on which it was taken and then unpacked, weighed and placed in a drying out cupboard.

The building material is then dried until a weight balance has been achieved, i.e. there is no further weight loss between the measurements. The weight difference between the sample in its original state and the sample in its dried state equals the percentage of moisture.

The following formula will allow you to calculate the mass-related content of moisture.

M = 100% * (WW – DW) / DW

- The sample is referred to as the wet weight **(WW)**
- The weight of the dried sample is referred to as the dry weight **(DW)**
- The moisture content is referred to as **M**

As the relative humidity of the surrounding air can quickly have an effect on the weight of the sample, it is crucial that the sample's actual weight is determined as swiftly as possible.