

Testing of Foams - Determination of hardness (indentation technique) according to ISO 2439

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User Benefits

- ◆ Conformity of the machine, fixtures and method with the ISO 2439 (Method A)
- ◆ Easy to use software to get indentation hardness index without any further calculation

Introduction

Foams are used in broad application field, and we contact them many times a day. The portfolio of different foams and by this also their characteristics are huge. The foams can roughly be separated in:

- Hard foams:
- Flexible foams.

Hard foams like polystyrene are for example known for their heat and acoustic insulating characteristics in the construction industries, as throw-away-dishes or as packaging material. Whereas flexible foams are used for mattresses, furniture padding, automotive seats, rinsing sponges but also for thermal and acoustic insulation and many other applications.

To characterize flexible foams and find the right foam in accordance with application or for quality control there are different ASTM, ISO or Company Standards. The mechanical properties determined in these tests are the compressive stress value, indentation hardness, compression properties, tensile strength and tear growth behavior.

The ISO 2439 describes different test methods for the determination of the hardness by indentation techniques. Therefore, the test piece of 380x380x50 mm is placed between a horizontal rigid surface with holes of 6 mm diameter in a 20 mm pitch and an indenter of 200 mm diameter.

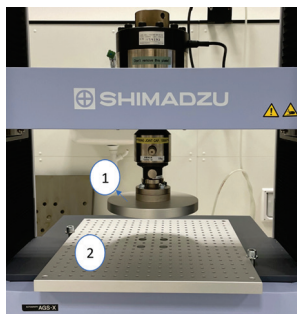


Fig 1 Testing set up
1. Indenter with 200 mm diameter;
2. Surface plate with 6 mm holes in 20 mm pitch

Table 1 Test Conditions

Device	: AGS-X100 kN
JIGS	: Special testing setup (Fig 1), ISO2439, Method A
Software	: TrapeziumX control, compression
Loadcell	: 100 kN
Speed	: 5-100 mm/min

Table 2 Specimen Information

Length	: 380 mm
Hight	: 380 mm
Thickness	: 50 ± 2 mm

Test Condition

Table 1 shows the test conditions. In this test, the compression force is measured by 100 kN loadcell with approved minimum load of 100 N. The specimen geometry for this test can be found in table 2. The Specimens were cut to the recommended length and conditioned at 23 ± 5 °C.

Based on ISO 2439, method A; the test is conducted in three steps which include:

1. Apply a force of 5 N to sample and measure the thickness of the test piece which is the point of zero indentation.
2. Indent the test piece at an indenter rate of 100 mm/min, to produce an indentation of 70 % of the thickness. After reaching this deflection, release the load at the same rate and repeat this loading and unloading twice more.
3. Immediately after the third unloading, indent the test piece by 40 % of its thickness. Maintain this deflection for a period of 30 s, report the corresponding force, in newtons (HA_{40%/30s}), and release the force.

Test Results

For the measurement, the specimen thickness at 5 N was calculated based on the upper jig stroke and The force deformation curve for five foams of different densities which can be found in the Fig. 2. The output data is reported in Table 3 and shows the Hardness HA_{40%/30s}. The sample deformation after loading is reported in Fig 3.

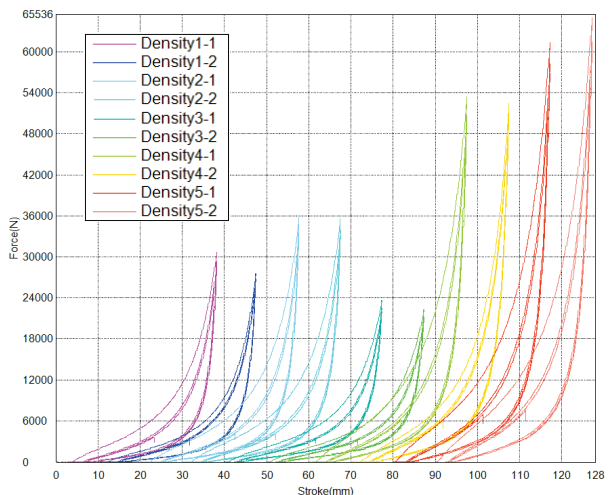


Fig 2 Force/Deformation Curve

Table 3 Details of tested foams

Name	HA _{40%/30s}
Unit	N
Density 1	2794,77
Density 1	2767,96
Average	2781,365
Density 2	3217,06
Density 2	3227,5
Average	3222,28
Density 3	2665,79
Density 3	2542,56
Average	2604,18
Density 4	4848,18
Density 4	4891,81
Average	4870
Density 5	5581,87
Density 5	5979,52
Average	5780,7
Total Average	3851,705

■ The Package

The recommended hardware and software configuration is listed below.

- ❑ *Main Unit*
AGS-X/AGX-V 100 kN Universal Testing machine
- ❑ *Accessories*
Special test plate for the lower plate
Spherical type Upper Joint
Loadcell for 100 kN
- ❑ *Software and Libraries*
TrapeziumX/TrapeziumX-V control
From now on, TrapeziumX-V is highly recommended for all autographs

■ Conclusion

The hardness of foams according to ISO 2439 can easily be determined by using a Shimadzu Universal testing machine in combination with special fixture according to the standard. The results show that the combination leads to stable and valid results.



Fig 3 deformation of sample after indentation loading