TÜVRheinland®
LGA

Prüfbericht - Nr.: 21149503
Test Report No.:

Auftraggeber: *Client:*	LIEN A Co., Ltd. 55/1A Khuong Viet Street, Phu Trung Ward, Tan Phu Dist., Ho Chi Minh City, Vietnam
Gegenstand der Prüfung: *Test item:*	Mattresscore
Bezeichnung: *Identification:*	„sample“
Serien-Nr.: *Serial No.:*	
Wareneingangs-Nr.: *Receipt No.:*	10035421
Eingangsdatum: *Date of receipt:*	14.05.2010
Prüfort: *Testing location:*	TÜV Rheinland LGA Products GmbH Tillystraße 2, 90431 Nürnberg, Germany
Prüfgrundlage: *Test specification:*	Durability test and evaluation of the resilience characteristics according to LGA guidlines and DIN EN 1997. 08:2000
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*
Prüflaboratorium: *Testing Laboratory:*	Möbelprüfinstitut Nürnberg *Furniture Testing Institute Nuremberg*

geprüft/ *tested by:*

28.05.2010	Globisch/Sachbearbeiter/*Expert*	
Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*

kontrolliert/ *reviewed by:*

28.05.2010	R. Heym/Laborleiter/Head of laboratory	
Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*

Sonstiges/ *Other Aspects:*

Order No. 1058469

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*
	F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*
	N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*
	N/T	=	*nicht getestet*		*N/T*	=	*not tested*

TÜV Rheinland LGA Products GmbH
Furniture Test Institute

TÜVRheinland®
LGA

Test report

No. 21149503
Order No. 1058469

Reported to: LIEN A CO., Ltd
55/1A Khuong Viet Street, Phu Trung Ward,
Tan Phu Dist.,
Ho Chi Minh City
VIETNAM

Object: Mattresscore "sample"
(1 sample supplied by the client)

Order: Durability test and evaluation of the resilience characteristics according to LGA-Guidelines and DIN EN 1957 : 08.2000

Findings

The mattresscore "sample" has been tested in a durability test rig with a roller load of 1400 N in two test stages with a total of 30 000 cycles. In the centre of the area three measurements of the characteristic curves of resilience have been taken as follows:

a)	after	200 strokes
b)	after	30 000 strokes
c)	after	60 000 strokes

The characteristic curves of resilience allow an assessment of the resilience and durability characteristics as well as the subjective hardness rating and the hysteresis.

Characteristics before the test

Hardness index:	6.32
Hysteresis:	10.0 %
Height of the system:	145 mm

Characteristics after the test

Change in height after the test:	0.9 mm
Change in hardness after 30 000 strokes:	-5 %
Change in hardness after the test:	-8 %
Resilience loss factor after the test: (deviating from DIN EN 1957)	1.7

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Managing Directors:
Hans-Hermann Ueffing, Jörg Maehler
Tax-No: 216/5715/1213 VAT No: DE 811835490

The data are determined based on the LGA-rating system limited to a maximum of 100 points.

The requirement for an increased quality level is 80 points *).

*) Note:
The minimum value for performance is 50 points. More than 70 points specific a good quality. At this the area under test has to be free of any damages / changes related to textile fabric and interior of mattress.

The reached total number of points for the 4 characteristic data is 100 points.

Change in height after test:	25 points
Change in hardness after 30 000 strokes:	25 points
Change in hardness after test:	25 points
Resilience loss factor after test:	25 points

The results of the test refer solely to the tested sample.

The following pages contain further information about test parameters and geometry of the roller, measurement conditions and design of the loading pad, modalities of assessment and rating system.

Nuremberg, 2010-05-28
569 hy/glb/şe

TÜV Rheinland
LGA Products GmbH
Furniture Testing Institute

i.V. F

Dipl.-Ing. (FH) R. Heym
Head of the Competence Centre

Martin Globisch
Responsible for the test

Test Results

Object

Article:	Mattresscore
Article denomination:	"sample"
Number of samples:	1
Delivered:	2010-05-14
Delivered by:	client
Reg.-No.:	10035421

Scope of tests

General examination

Durability test in two stages according to LGA-Guidelines 33003 and DIN EN 1957 : 08.2000

- Stage 1: 30 000 strokes with 15 000 cycles
- Stage 2: 30 000 strokes with 15 000 cycles

Evaluation of resilience characteristic curve

- after 200 strokes = 100 cycles
- after 30 000 strokes = 15 000 cycles
- after 60 000 strokes = 30 000 cycles

Assessment of the Force-Displacement-Plot according to LGA-Guidelines 33003 and the actual state of art of the European Standardization. Determination according to the LGA-rating system limited to a maximum of 100 points.

Applicability of test results

The test results refer solely to the samples tested. The digital photos - if any - serve only for additional explanation and do not constitute any part of the test report.

Tolerances

Unless otherwise stated dimensions are measured to an accuracy according to DIN 7168-g for old design and DIN ISO 2768, Part 1 "c" for new design. For all other physical values the measurement uncertainty < 5 %. The tests were carried out under standard indoor conditions unless otherwise stated.

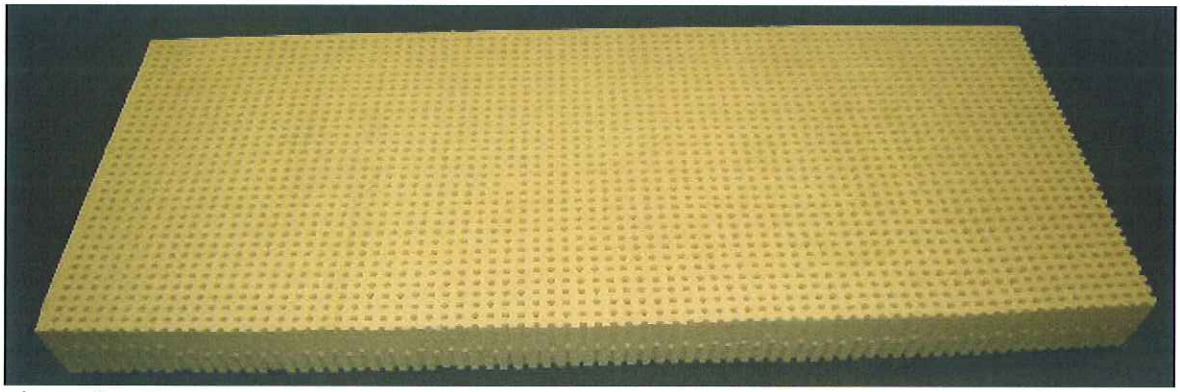
General examination

Dimensions

Length:	1791 mm
Width:	797 mm
Height:	145 mm
Weight:	18.2 kg
Density	87.93 kg/m²

Design

Core: ca. 14 mm mattresscore Latexfoam with aeration wholes both sides.



view of mattress core

Durability Test - Roller Test

Test Rig

The durability test is carried out by means of an electromotive driven roller test device.
A specified roller made of lacquered hard wood rolls over the mattress that is placed on a levelled, rigid, flat base and fixed to prevent slipping.
Rotation symmetric roller

- Length 1000 mm
- Length of the medium section 400 mm, Ø 300 mm
- Spherical ends reduced to Ø 250 mm
- Outer edges with radius: 20 mm
- Roller load 1400 N

Test parameters

Length of stroke:	500 mm
Cycle:	1 cycle consists of one forward and one backward stroke in sinusoidal motion
Rolling strain:	symmetric over the width of the mattress Stage 1 for 30 000 strokes = 15 000 cycles Stage 2 for 30 000 strokes = 15 000 cycles Total test for 60 000 strokes = 30 000 cycles
Roller drive:	horizontal directed force
Test rate:	16 ± 2 cycles per minute
Condition in the test bay:	Standard climate, 23/50-2, DIN 50 014

Visual examination

The mattress has been checked before, during and after the durability test. A necessary interior check is carried out after test and evaluation.

Determination of resilience characteristics (Force-Displacement-Plot)

Measuring set-up and conditions

A loading pad as specified applies and removes a load to the mattress at the area of its centre of gravity with linear speed.

The load is measured by means of a piezoelectric load cell at the loading pad, the actual compression by means of an inductive displacement sensor.

The fourth characteristic curve after 3 loads applications of 1000 N and removal of the load will be recorded.

Measurement uncertainty: ± 1 %

Design of the loading pad:

Spherical pad, diameter 355 mm
Curvature radius 800 mm (surface 1000 cm²)

Travel speed: 90 mm/min

The resilience characteristic curves as Force-Displacement-Plots with the axes compression force and depth of impression are taken

a) after 200 strokes = 100 cycles
b) after 30 000 strokes = 15 000 cycles
c) after 60 000 strokes = 30 000 cycles

with a recuperation time of at least 5 hours each.

Assessment of the Force-Displacement-Plot

Change in height and **change in hardness** as well as **resilience loss** are dimensions of durability as measurable functional characteristics.

Change in height

The change in height is determined after testing under a load of 50 N applied by the loading pad.

The change in height in mm indicates how intensive the mattress will visibly deform under frequent use.

Hardness rating and change in hardness rating

The hardness rating is calculated as mean inclination of the Force-Displacement-Plot at a load of 210 N, 275 N and 340 N.

$$H = \frac{C_1 + C_2 + C_3}{3} \; N/mm^2$$

C_1 Inclination at a load of 210 N
C_2 Inclination at a load of 275 N
C_3 Inclination at a load of 340 N

The change in hardness rating in percent is calculated from the relations between the hardness rating after test stage 1 and 2 to the hardness rate before the test.

Resilience loss factor (deviating to DIN EN 1957)

It is calculated from the quotient of the areas between curve a) and c) and the rectangle that is formed by the perpendiculars from the end point of curve c) and the coordinate axes multiplied by the factor 100.

Also the resilience loss factor indicates how the resilience and elasticity of the mattress change during the test. It shows especially how the characteristic curve deviates in the curvature after test from the one before testing.

Determination of subjective hardness rating H_S

The rating of the subjective hardness is determined by means of hardness value H, that is based on results of empiric studies and indicates the subjective valuation by the user. The subjective hardness rating H_S is a figure on a scale from 1 to 10 that indicates the hardness of the resilience.

$H_S = 1$ is a hard resilience, $H_S = 10$ is a soft resilience

H_S is determined according to the following function:

$$H_s = 10\left(1 - e^{-(K \cdot a + b)}\right)^2$$

K is calculated with the following equation from the Force-Displacement- Plot

$$K = \frac{A}{H}$$

Where:

A = Area under the curve from 0 to 450 N from the Force-Displacement-Plot

H = Hardness rating

a = 5.92×10^{-4}

b = 0.148

Determination of the hysteresis

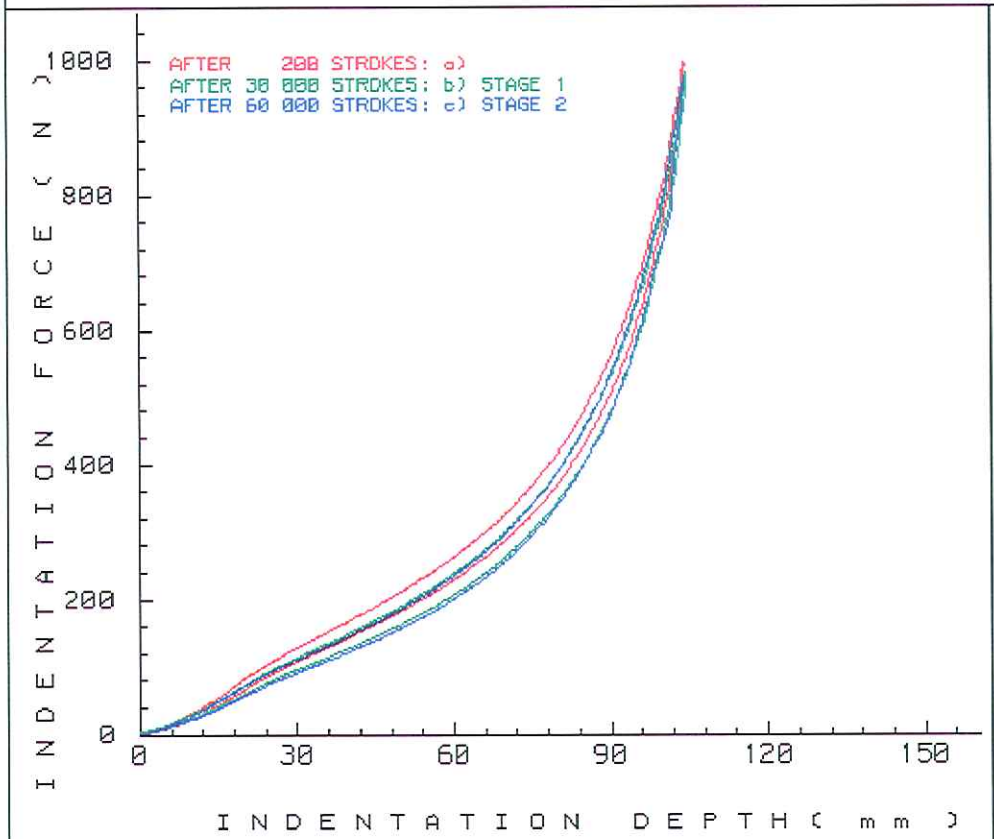
The per cent hysteresis is calculated from the quotient of the area enclosed by the load and reload curves and the area below the load curve (up to max. depth of indentation at 1000 N) multiplied by a factor of 100.

The hysteresis value is a measure of the ratio of applied force and withdrawn force and characterizes how freely the user can move on the mattress (change in sleeping position).

Results of measurement and assessment

The following pages contain the Force-Displacement-Plot, results of measurement and assessment as well as rating points according to LGA-rating system.

MATTRESS RESILIENCE CHARACTERISTICS



LGA-
MÖBELPRÜFINSTITUT
DATE:2010-05-28
SPECIALIST:Globisch

OBJECTD:Sample of Latex foam
CLIENT: Fa. Lien A

DETERMINATION OF CHARACTERISTICS

sample of Latex foam

DATA AFTER 200 STROKES

HARDNESS RATING H	6.31 N/mm
AREA A (0-450N)	15335 Nmm
HARDNESS VALUE K	2429 mm²
SUBJECTIVE HARDNESS Hs	6.32
HYSTERESIS	10 %

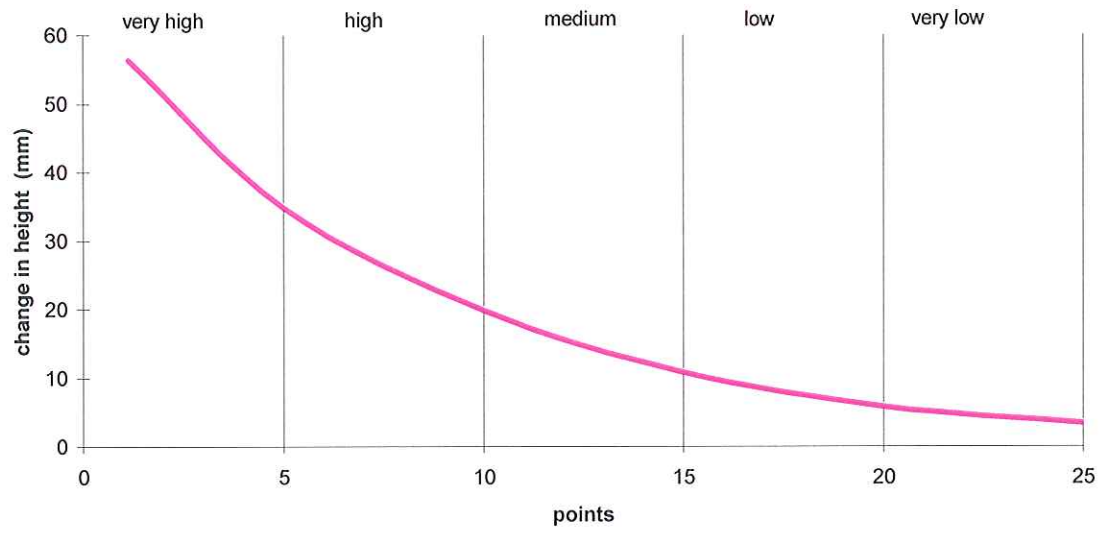
DURABILITY CHARACTERISTICS

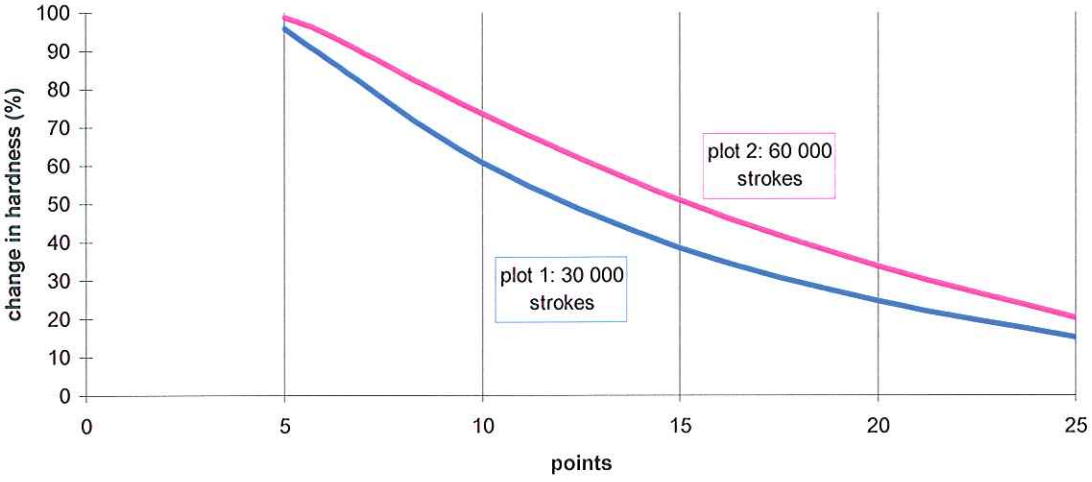
CHANGE IN HEIGHT	.9 mm
CHANGE IN HARDNESS (STAGE 1)	-5 %
CHANGE IN HARDNESS (STAGE 2)	-8 %
RESILIENCE LOSS FACTOR	1.7

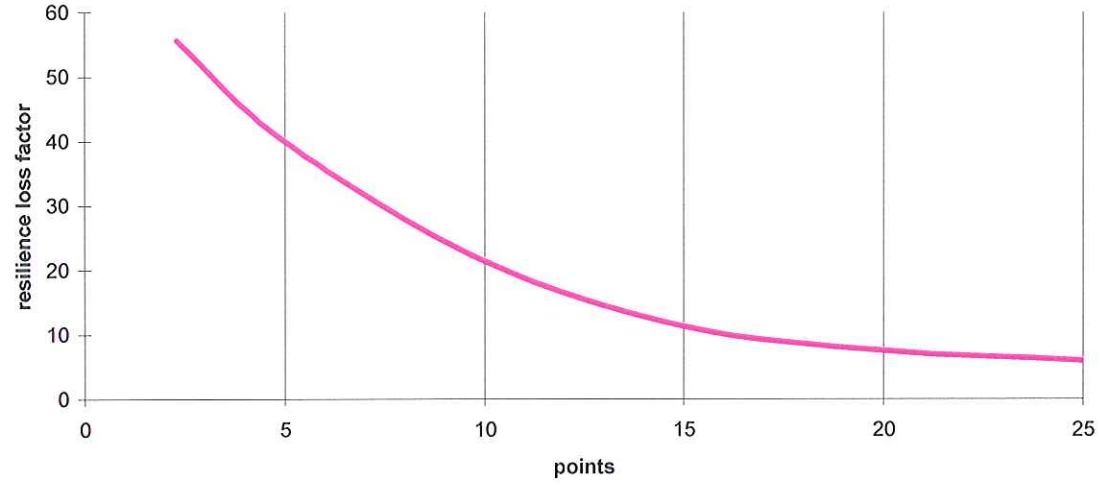
DURABILITY RATING

CHANGE IN HEIGHT	25
CHANGE IN HARDNESS (STAGE 1)	25
CHANGE IN HARDNESS (STAGE 2)	25
RESILIENCE LOSS FACTOR	25
TOTAL NUMBER OF POINTS (MAX. 100 POINTS)	100

LGA Rating System







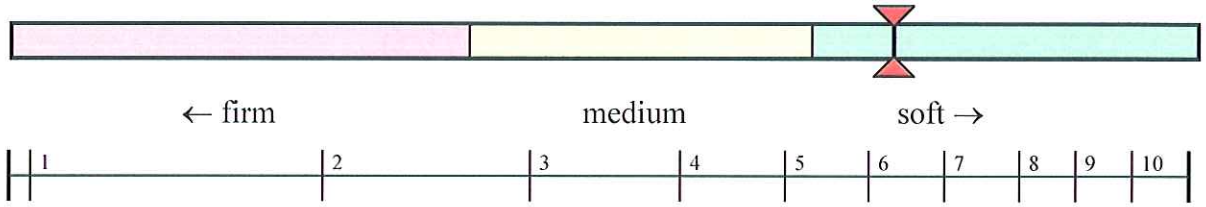
Results of the visual examination

The area under test did not show any damages / changes related to textile fabric and interior of mattress.

Results and evaluation according to DIN EN 1957

Data	Start	15 000 cycles	30 000 cycles
Hardness H_S	6.32	6.01	5.83
Change in hardness	/	- 5 %	- 8 %
Change in height	/	1,0 mm	0.9 mm

Assessment of firmness rating (proposal)*



* proposal

The assessment of firmness rating is not part of DIN EN 1957. The proposal is based on empiric data of LGA and is not mandatory.

Attachment to LGA – Rating scale

The results obtained under durability testing (loss in height, changes in hardness and resilience loss factor) were evaluated analogous to the weighting curves and provided with rating scores (points).

Considering the significant influence of the lying hardness factor H_S on the evaluation, the single results of the changes in hardness and the resilience loss factor were weighted with a corrective factor which is calculated by using the following formula:

$$P = P'\left(\frac{25}{P'}\right)^{\left[\left(\frac{1}{10H_S}+0{,}99\right)^4 - 1\right]}$$

P = Corrected score
P' = Score / weighting curves
H_S = Medium lying hardness value determined of measurements a, b and c