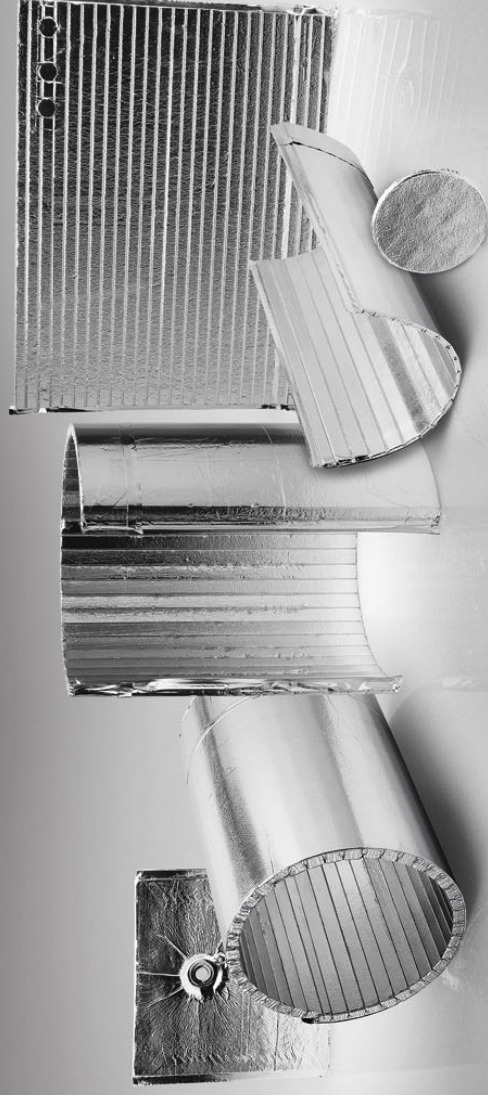


Vacuum Insulation Panels with Overlapping Edges



**and Other Improvements in the Ways a
VIP can be Manufactured**

IVIS London, September 17, 2009
Dr. Roland Caps

Who is va-Q-tec?

- Production of high quality Vacuum Insulation Panels (VIPs) and PCM Components
- Design, validation and production of high performance thermal packaging solutions
- Thermal engineering laboratory
- Several awards for the advanced VIP technology
- 7.000 m² production area with 4 VIP Production lines and PCM production
- Production scale: several 100 000 VIPs and many 10 000 of boxes and containers,
 > 1 Mio. pcs PCMs
- 50 employees, among them 5 physicists and 6 junior Scientists
- two production sites



va-Q-tec AG
Factory I in Würzburg / Germany

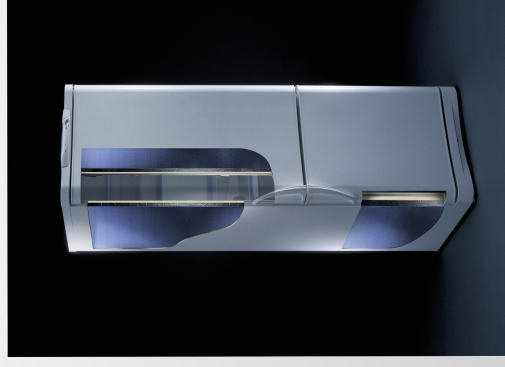
Our Markets



Packaging /

Logistics:

Biotechnology,
pharmacy,
medicine, food, etc.



Appliances

Refrigerators,
freezers,
boilers,



Building insulation:

Construction,
energetic renovation,
facades,
etc.



Mobility /

Technics:

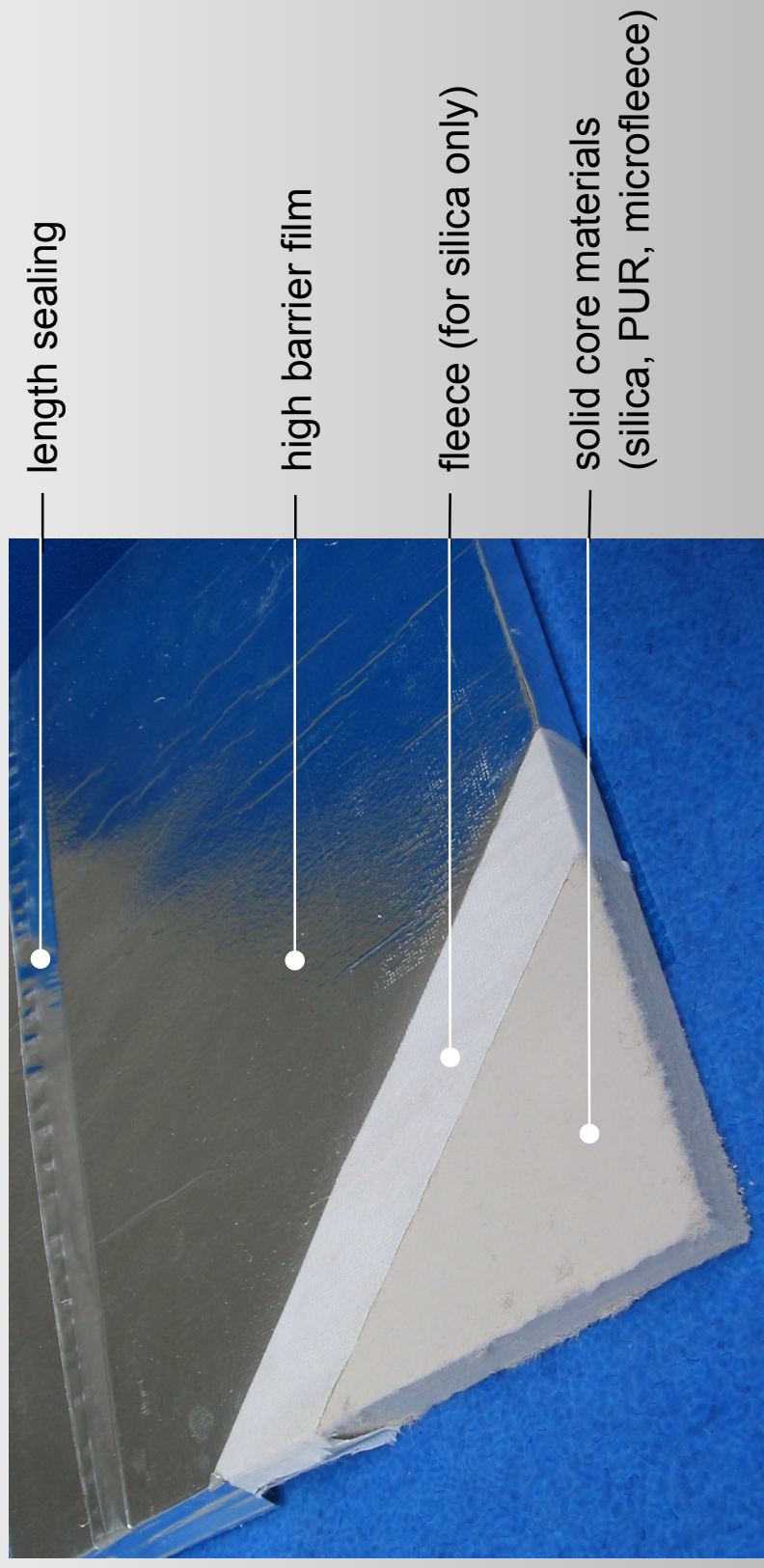
Refrigeration
trucks,
mobile houses,
aircrafts, trains,
Technical devices

Overview

New Features of va-Q-tec Vacuum Insulation Panels

- Glass Fibre Textile Protective Cover for Building Applications
- New Type of Powder Filled Vacuum Panels
- Overlapping VIPs
- Enhanced Quality Assurance Procedures

Classical va-Q-vip Composition



For Buildings: Additional Glass Fibre Textile Cover

glass fibre textile is
laminated to surface
of high barrier film

=> **better protection
against damage**

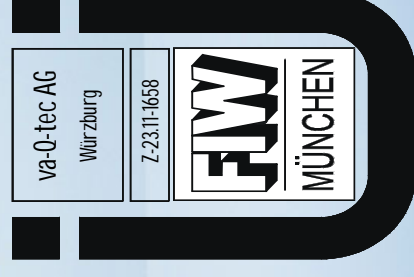
=> **fire classification
„B2“**

Certification no.
Z-23.11-1658

Product: **va-Q-vip B**

official
value of
thermal
conductivity
including aging
and edge heat
losses:

0,008 W/mK



Bemessungswert Wärmeleitfähigkeit 0,008 W/(mK)
Baustoffklasse B2

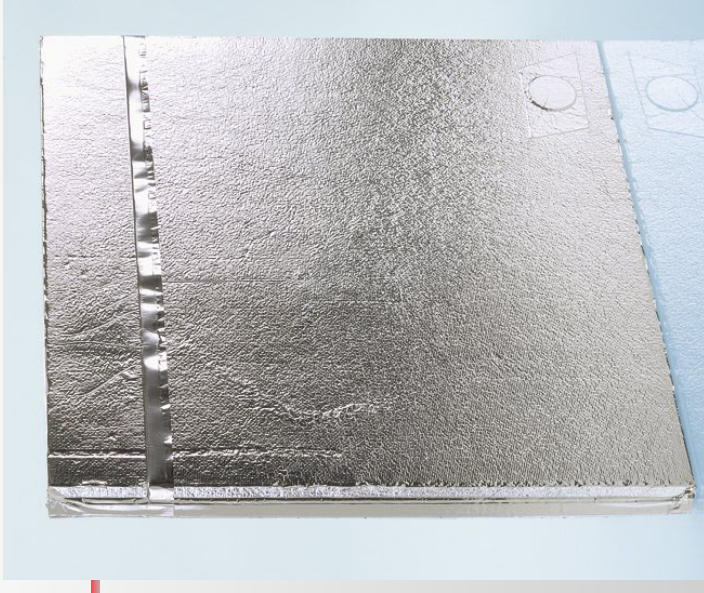
DIBT Official Approval for Buildings

Production Technologies

standard procedure

- press rigid board from fumed silica powder
- cut board to customer size
- dry board in oven
- wrap in high barrier film
- evacuate and seal bag in vacuum chamber

=> **va-Q-vip**



economic production process

- fill silica powder into bag
- evacuate and seal bag in vacuum chamber

=> **va-Q-plus**



Advantages of New Production Technology “va-Q-plus”

L-form



curved panels



- variant in shape and thickness
- easier to make complex forms
- lower thermal conductivity
(0.005 => 0.0035 W/mK)

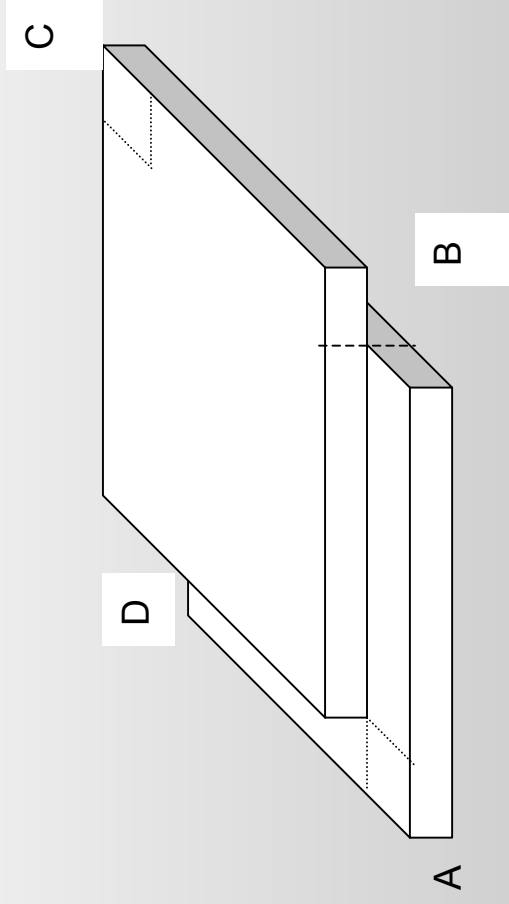
For Buildings: va-Q-plus B

- va-Q-plus can be equipped with glass fiber protection textile as va-Q-vip B
=> “**va-Q-plus B**”
- very good protection of corners against damage due to hard sealing flange
- thin panels may overlap a few millimeter as thickness of edges is only smoothly increasing



- for thicker panels (> 15 mm): an up to 50 mm wide range of reduced thickness at the edges may be applied => **va-Q-tile**

VIPs with Overlapping Edges: va-Q-tile



- edge area is only half the thickness of overall area
- corner thicknesses are only one fourth of area thickness
- edge thermal losses are minimized if panels overlap

Installation of va-Q-tile with Overlapping Edges

VIPs with decreased thickness at the edges

- ⇒ lower thermal losses by overlapping
- ⇒ more flexible installation

house facade was successfully
equipped with va-Q-tile and plaster
finish



Calculation of Edge Losses

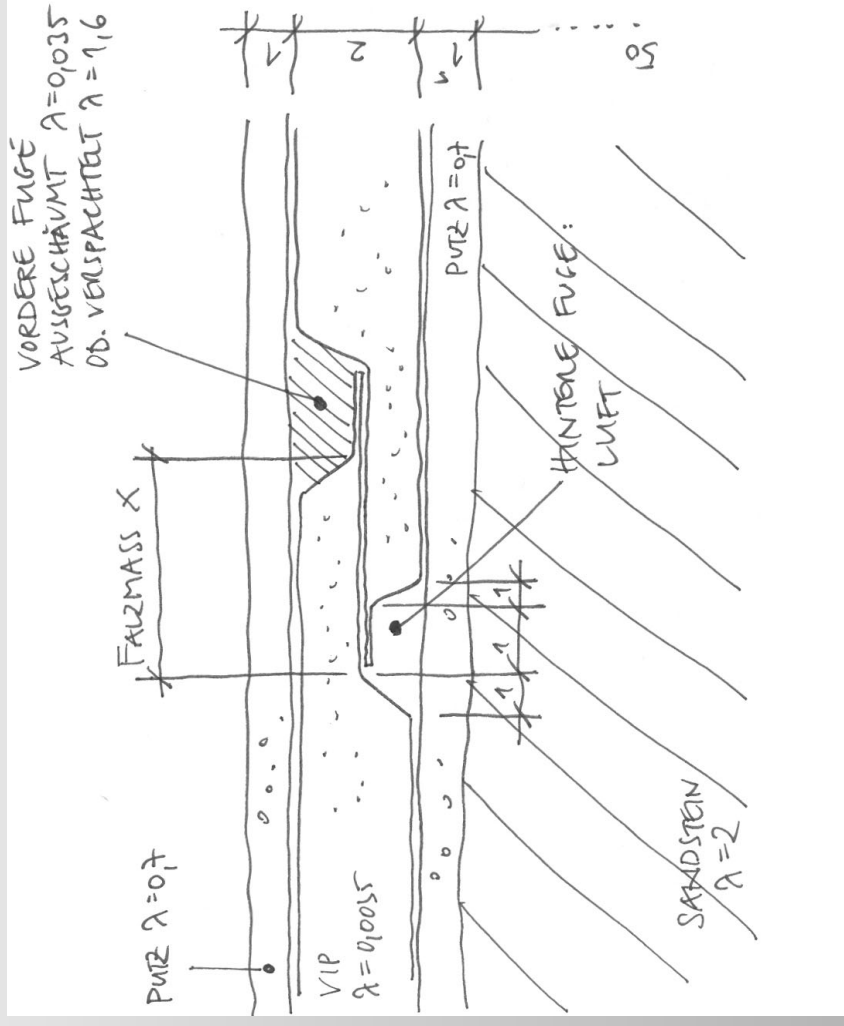
Performed by Markus Binder,
University of Applied Sciences, Stuttgart

panel size:
1000 mm x 500 mm

thickness: 20 mm

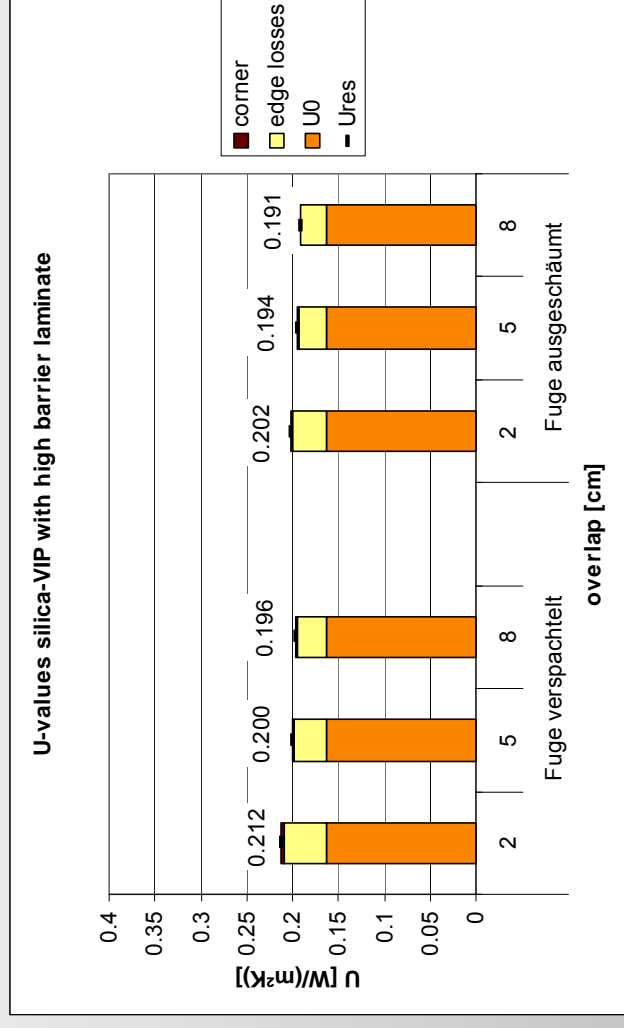
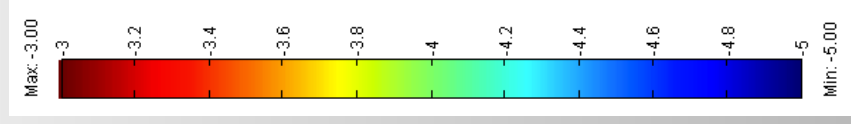
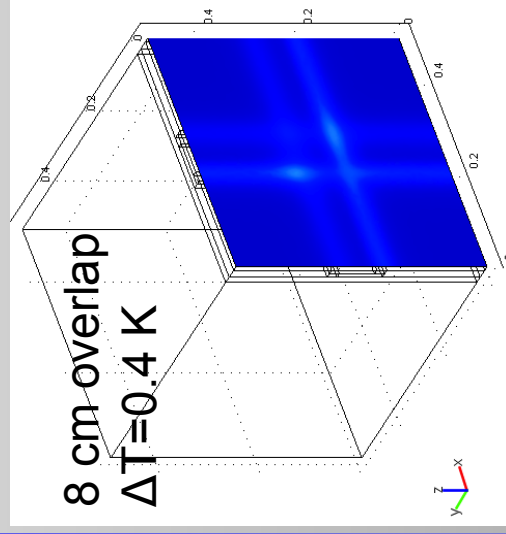
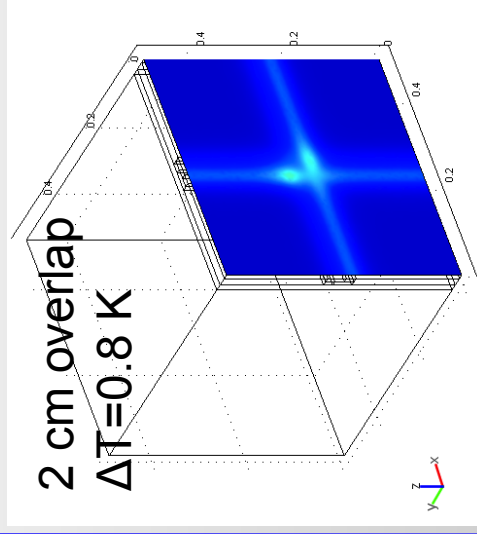
initial thermal cond.:
0.0035 W/mK

both sides of VIPs are
covered by plaster



Results Edge Losses

temperature distribution at 20 °C / -5 °C:



edge losses are below 0.6 mW/mK,
effectively

almost no temperature increase on surface

Test Area Renovation of a School Building: 2 cm va-Q-tile + 3 cm PU-insulation + 1 cm plaster



glued VIPs



VIPs with PU-insulation

Test Area School Facade



Final Plaster Finish

Start of Renovation:
September 2009



Quality Procedures

What does the customer expect:

- low thermal conductivity
- long service life time
- reliability

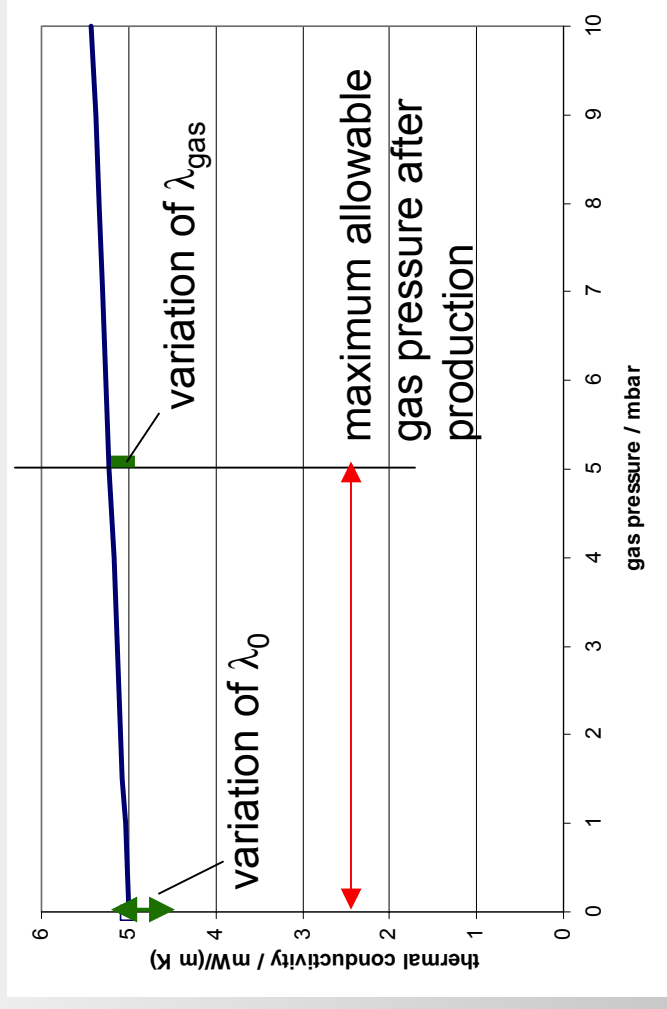
example: va-Q-vip B

DIBT effective th.cond. value:

0.008 W/mK

requirements **after production**

according to DIBT:



- (1) th. cond. λ_0 max. 5.3 mW/mK $\xrightarrow{\lambda(t) = \lambda_0 + 26/(1 + p_{1/2} / p_{\text{gas}}(t))}$
- (2) th. cond. λ_{1000} max. 20 mW/mK $\xrightarrow{p_{1/2} = 600 \text{ mbar}}$
- (3) gas pressure $p_{\text{gas}}(t=0)$ max. 5 mbar $\xrightarrow{100 \% \text{ control}}$
- (4) life time beyond 25 year $\xrightarrow{p_{\text{gas}}(t) \Rightarrow}$ gas transmission of film envelope

Essential Internal Test Procedures

control of envelope raw material

method: test of gas and water vapour transmission of envelope

⇒ $p_{\text{gas}}(t)$

control of core raw materials and control of core production:

method: thermal conductivity measurement of sample VIPs

- freshly evacuated (< 2 mbar)
- airfilled (or at ~ 100 mbar)

⇒ λ_0 and $p_{1/2}$ (slope of conductivity increase with gas pressure)

control of VIP-production (evacuation, sealing, envelope)

⇒ measurement of initial gas pressure

- $p_{\text{gas}} < 5$ mbar
- gas pressure increase below 100 mbar / year

$p_{\text{gas}}(0)$ and $p_{\text{gas}}(t_1)$

External and Internal Test Procedures

by **external test institute:**

e.g.:

thermal conductivity measurement

simulated aging of panels: storage at 80 °C / increase of th. cond.

internal test procedures

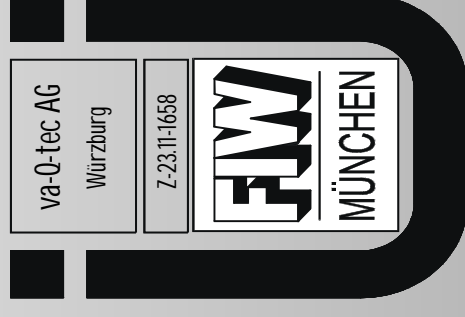
are regularly (twice a year) monitored and certified by
external institute:

e.g. daily test of thermal conductivity

shape, dimension, compression

100 % test of gas pressure (any VIP)

test of film quality

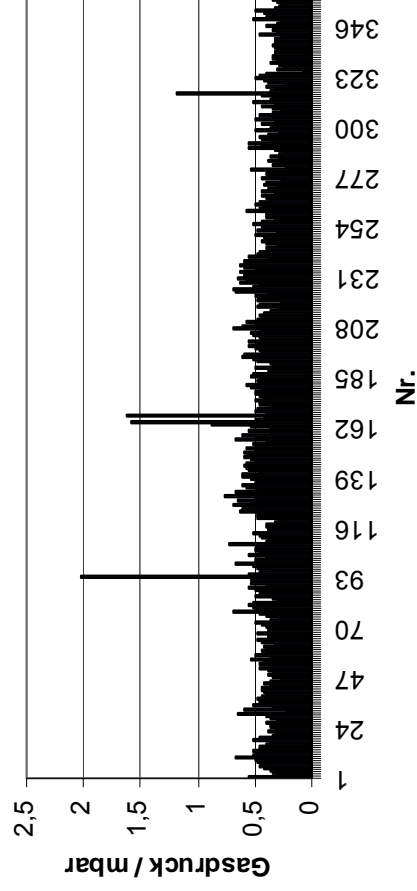


Bemessungswert Wärmeleitfähigkeit 0.008 W/(mK)
Baustoffklasse B2

Gas Pressure Control with va-Q-check System

- low cost sensor system for VIP
internal gas pressure:
va-Q-check (sensor chip inside VIP)
- 100% control of production & during
installation
- external measurement head
- measurement time: ca. 5 - 10 sec

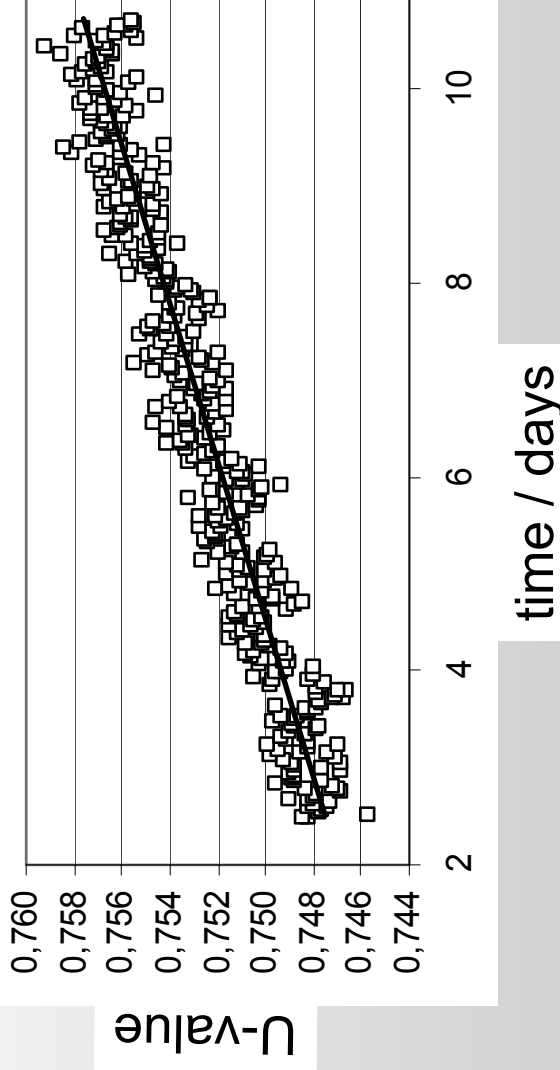
Gasdruck VIP Silica-Kerne, je 5s Messzeit



measurement range: 0.02 – 10 mbar

Measurement of Gas Transmission of Envelope

method:
increase of thermal conductivity of special, standardized test panel is measured



Example:

sample VIP covered with **aluminum laminate foil**
measured increase of U-value $\Delta U/\Delta t$: 0.0012 W/(m²K day)

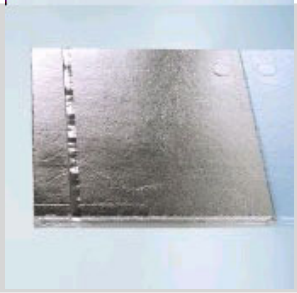
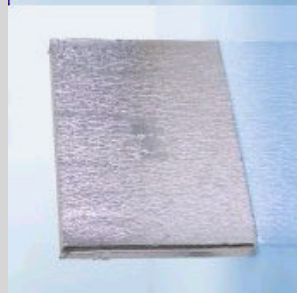
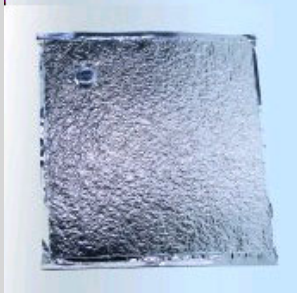

⇒ increase of gas pressure

$$\Delta p_{\text{gas}} / \Delta t = 0.15 \text{ mbar/year}$$

⇒ dry air transmission of envelope:

0.7 mbar litre/(m²VIP year)

VIP Comparison – Different Core Materials

	va-Q-vip	va-Q-pur	va-Q-mic	va-Q-plus
core material	silica board	polyurethane board	micro fleece board	silica powder
thermal conductivity (W/m*K)	0.005	0.008	0.0025	0.0035
density (kg/m³)	200	65	220	180
forms	rectangular	rectangular	rectangular	flexible
maximum size	1200 x 1000	1300 x 1000	1300 x 1000	1750 x 1000
price	middle	middle to low	middle to low	low
available since	2001	2005	2006	2008
				

Thank you for your attention

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