Development on New Vacuum Insulation Panel "CHIP-Vacua"

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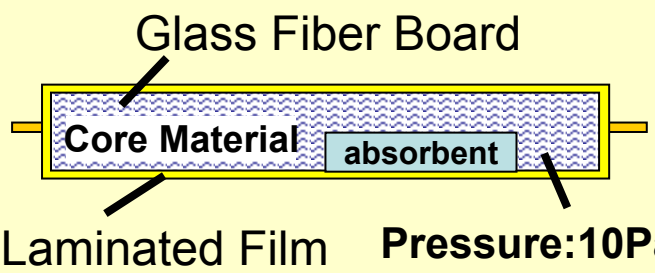
Contents

Panasonic
ideas for life

Conventional Vacuum Insulation Panel

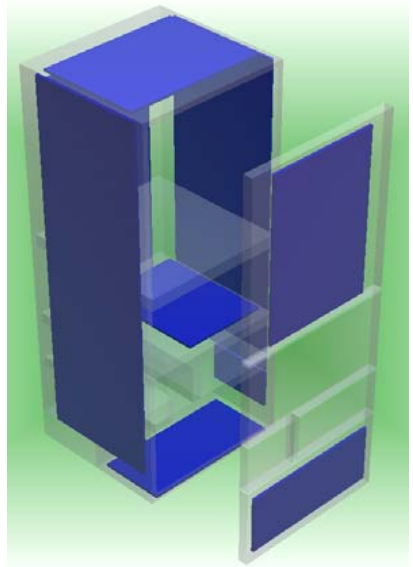
U-Vacua (conventional)

Structure & Feature



Thermal Conductivity
0.0020W/mK

Application to Refrigerator



NR-F461A(2004)

U-Vacua

Energy Consumption
about 1/8 compared to 10 year ago model

Problem

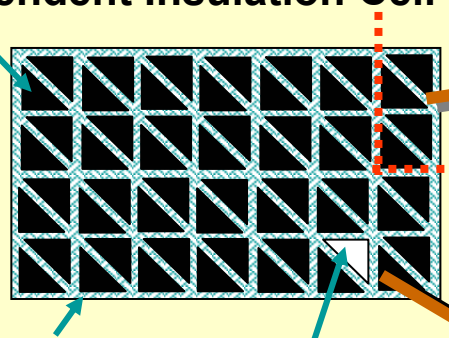
- Limited Shape… Applied to Only Flat Surface, Due to Flat Square Shape
- Careful Handling… Difficult to Maintain Vacuum Level by Cutting or Driving a Nail

Developing Product, “CHIP-Vacua”

CHIP-Vacua

Aggregation of Insulation Cells

Independent Insulation Cell



Feature

1. Insulation Property

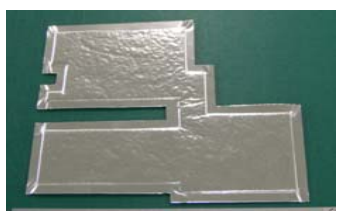
Various Thermal Conductivity
by Arranging Cell Pattern
Ex:0.0020-0.0100W/mK(Cell Area 70-100%)

2. Flexible

Folding at Sealed Part between Cells

3. Shapeable

Applicable to Various Objects



Cut by Sealed Part
along Insulation Cell

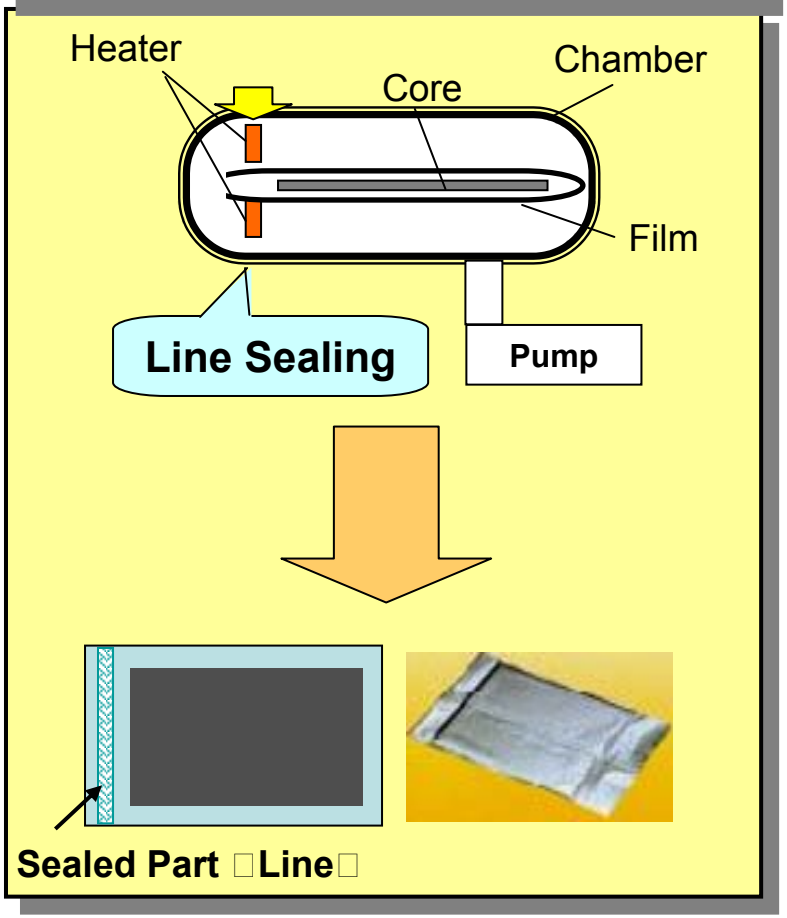
4. Easy Handling

Maintaining High Insulation Property

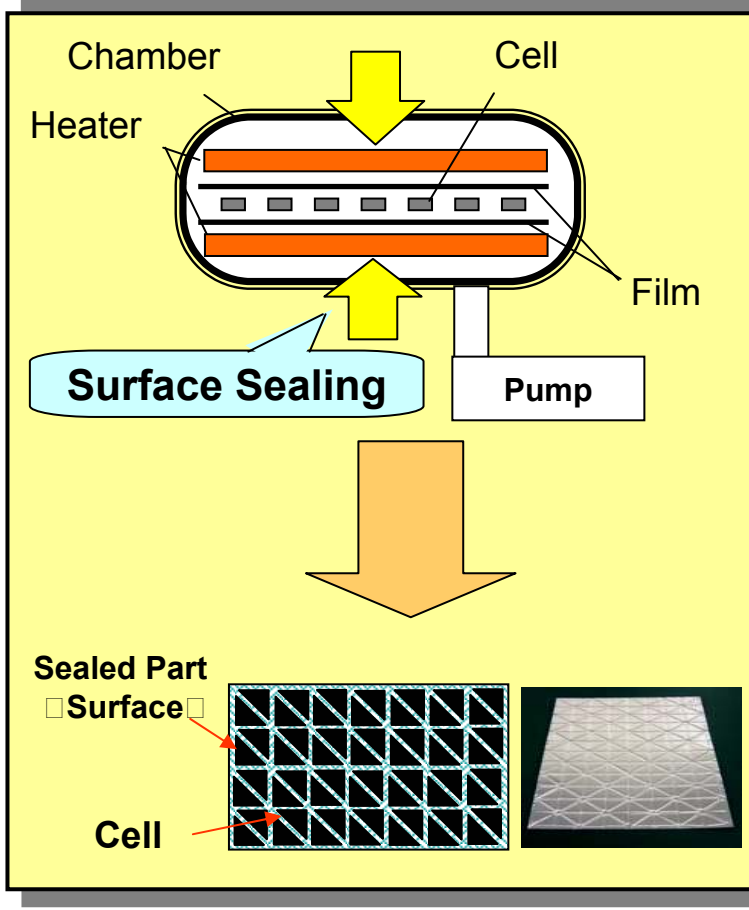
Each Cell is Independent
Small influence of Broken Cell

New Manufacturing Technology

Conventional Technology
(U-Vacua)



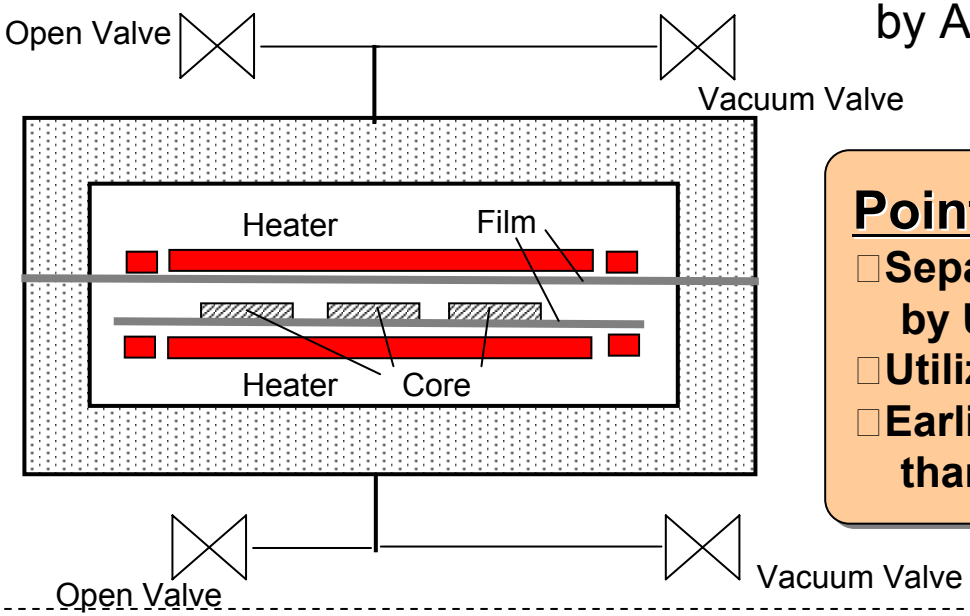
CHIP Technology
Composition of **H**eat **I**nsulation **P**attern



Realization of Various Shape VIP by CHIP Technology,
Independent of Film's Shape □ Improvement of VIP Applicability

Concept of New Technology

■**Outline…** Heating the Film in the Chamber, then Sealing the Film by Atmospheric Pressure when Air Introduction



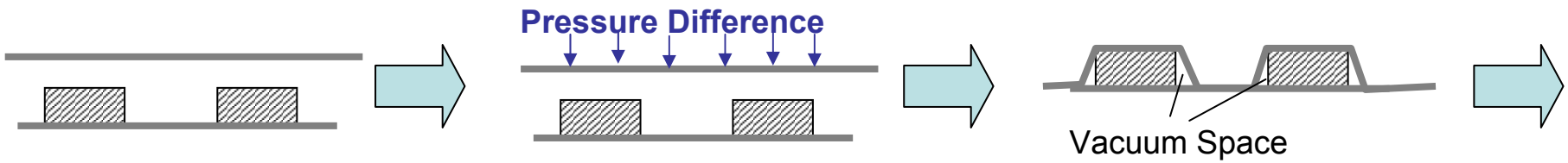
Point

- **Separating the Chamber into 2 Space by Upper Film**
- **Utilizing the Air Pressure as Sealing Pressure**
- **Earlier Air Introduction to Upper Space than Below Space**

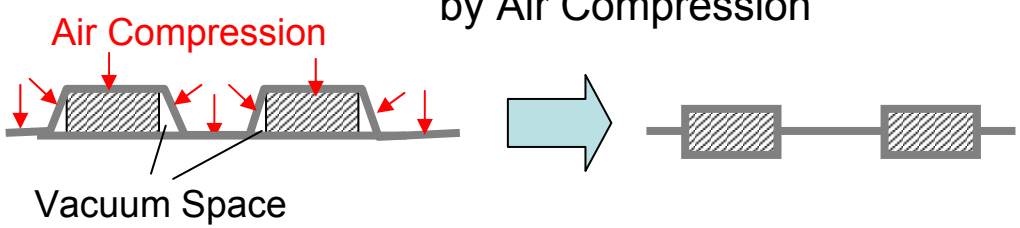
■**Sealing Process**

1. Evacuating

2. Air Introduction…Upper Film Adheres to Below One by Pressure Difference



3. Introduction End…Sealing the Film along the Core by Air Compression



Point

- **Controlling the Air Introduction Secures the Surface Sealing**

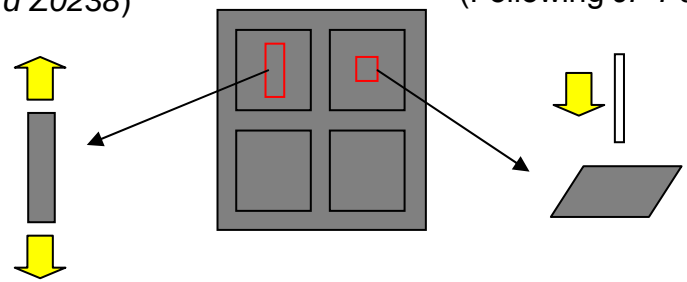
Investigation of Heat Damage

■Damage of the Film heated in the Chamber Compared to the Original Film

□Pulling Intensity…Force at Elastic Limit

(Following *Japanese Industrial Standard Z0238*)

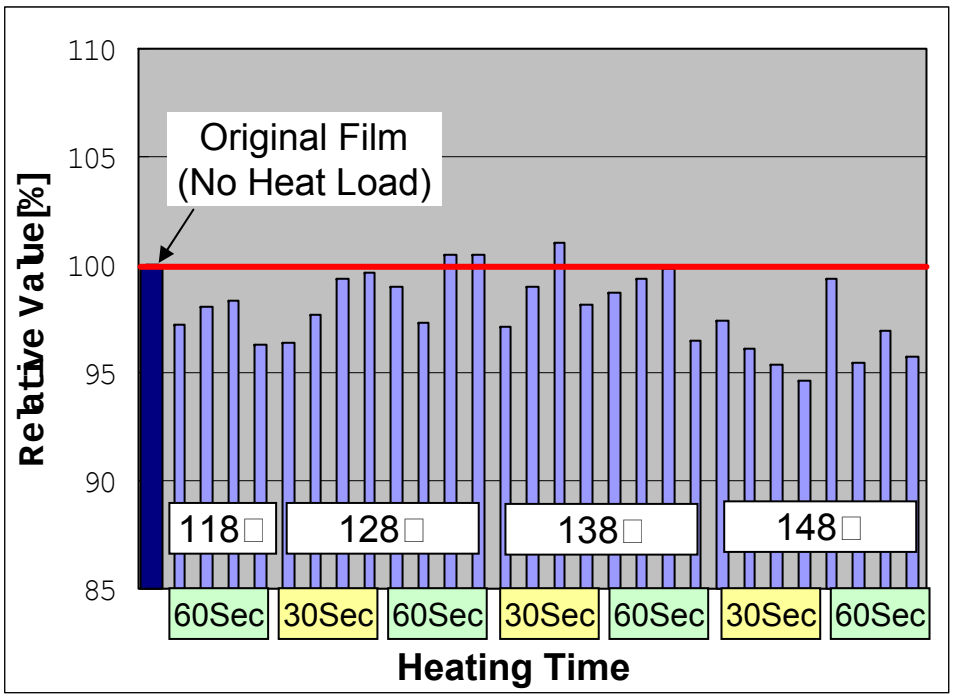
Sample Size:15mm*90mm
Pulling Rate:200mm/min

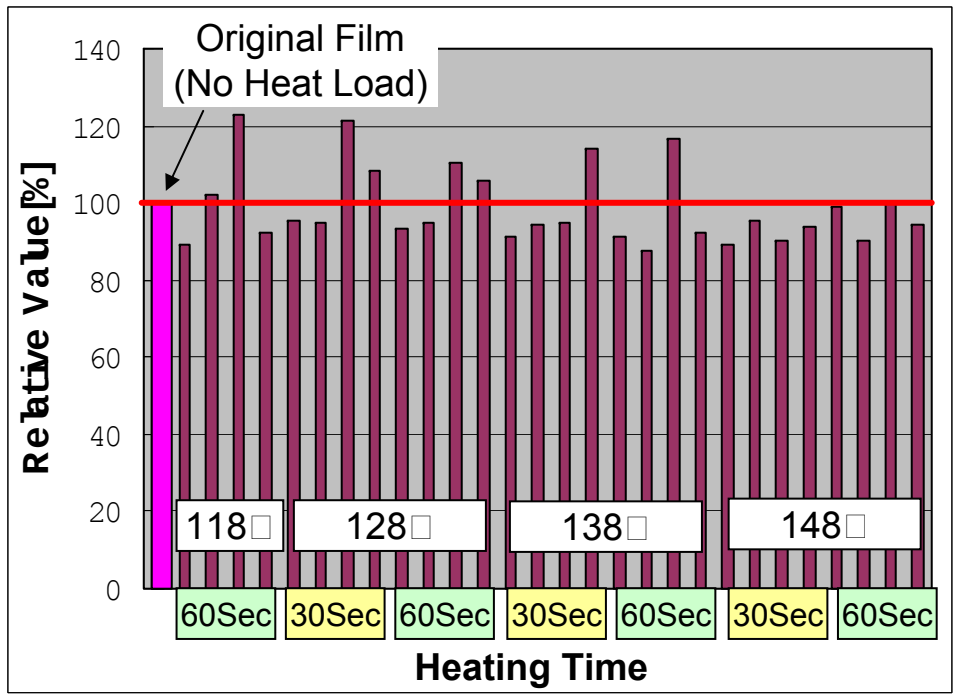


□Sticking Intensity…Force when Piercing

(Following *JP Food Hygiene Act No.20*)

Sample Size:20mm*20mm
Sticking Rate:50mm/min
Needle Diameter 0.5mm





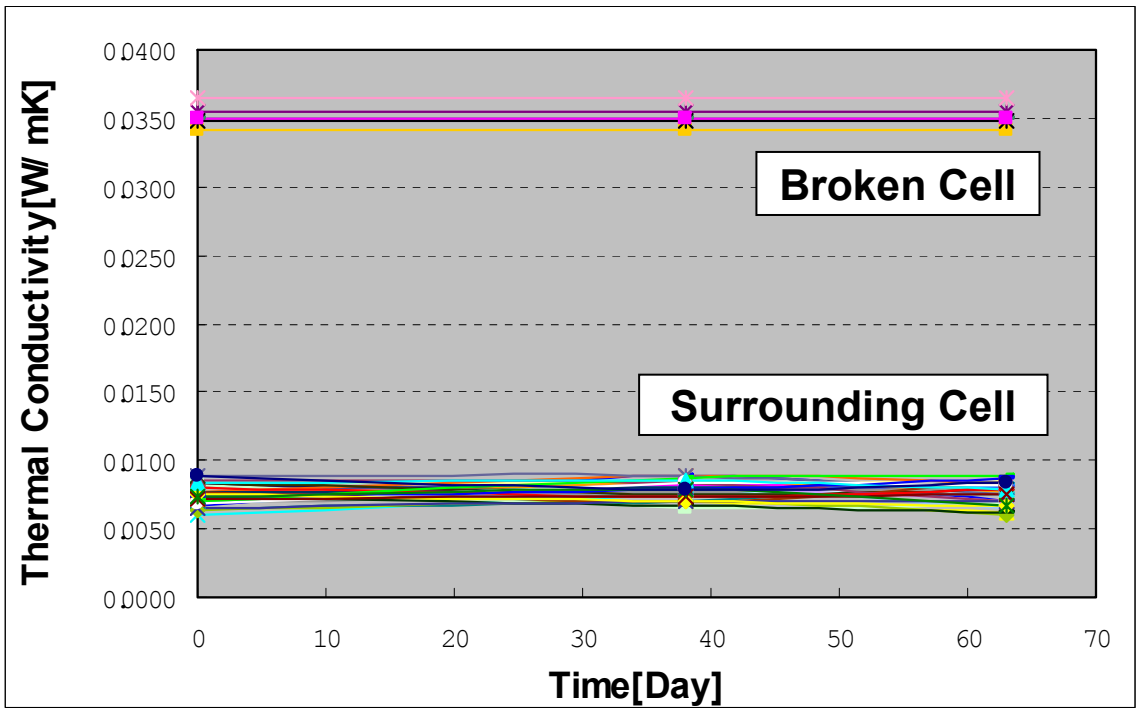
The Same Value as the Original Film's□No Heat Damage in CHIP Process

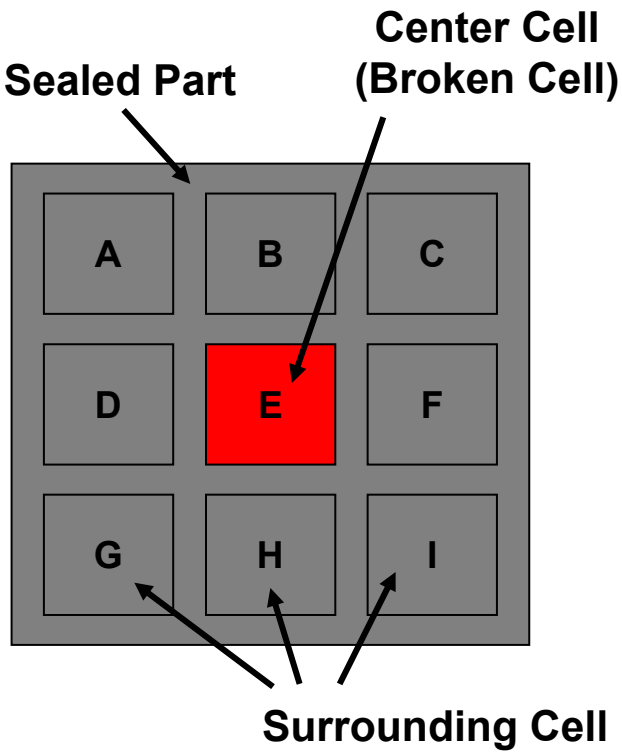
Investigation of Sealing Quality

■**Purpose**…Inspection of Surface Sealing(Sealing between Cells)

■**Method**…Observing Thermal Conductivity of the Cells Surrounding the Broken Center Cell

■**Result**





Surrounding Cells have No Influence of Broken Cell
□**Securing Sealing Quality** **(Sealing Intensity;more than 70N)**

Specification for New Technology

■Producible Type

	Interval between Cells			
Thickness	20mm	15mm	10mm	5mm
5mm	○	○	○	○
10mm	○	○	○	×

CHIP-Vacua

Producible CHIP-Vacua by New Technology
…VIP Thickness ~10mm, Interval between Cells 5mm~
*Now under Investigation for Improvement of Product Specification

Total Thermal Conductivity for CHIP-Vacua

■CHIP-Vacua Type

Interval Between Cells	Total Thermal Conductivity (Ratio of Cell Part)		
	□30mm	□60mm	□90mm
5mm	 0.0088W/mK (77%)	 0.0065W/mK (88%)	 0.0055W/mK (93%)
10mm		 0.0087W/mK (78%)	
20mm		 0.0123W/mK (60%)	

□**Calculation of Total Thermal Conductivity, λ**

$$\lambda = \lambda_c S_c + \lambda_s S_s$$

λ_c :Thermal Conductivity of Cell Part

λ_s :Thermal Conductivity of Sealed Part (0.0250W/mK)

S_c :Area of Cell Part

S_s :Area of Sealed Part

Total Thermal Conductivity

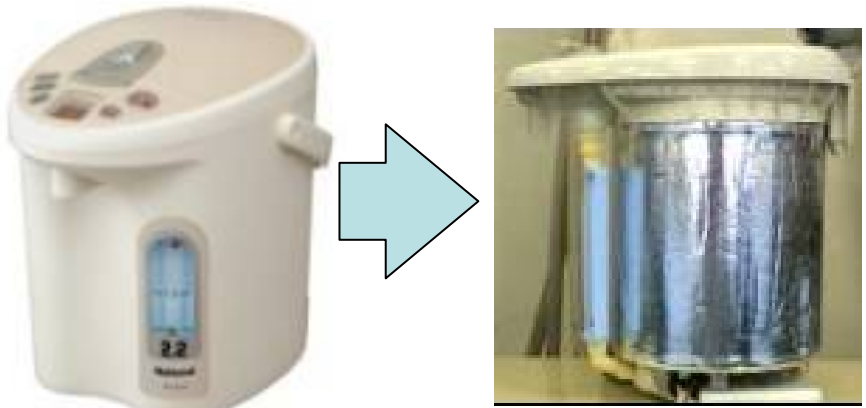
…Weighted Average Based on Each Area, Thermal Conductivity

Inspection of Total Thermal Conductivity

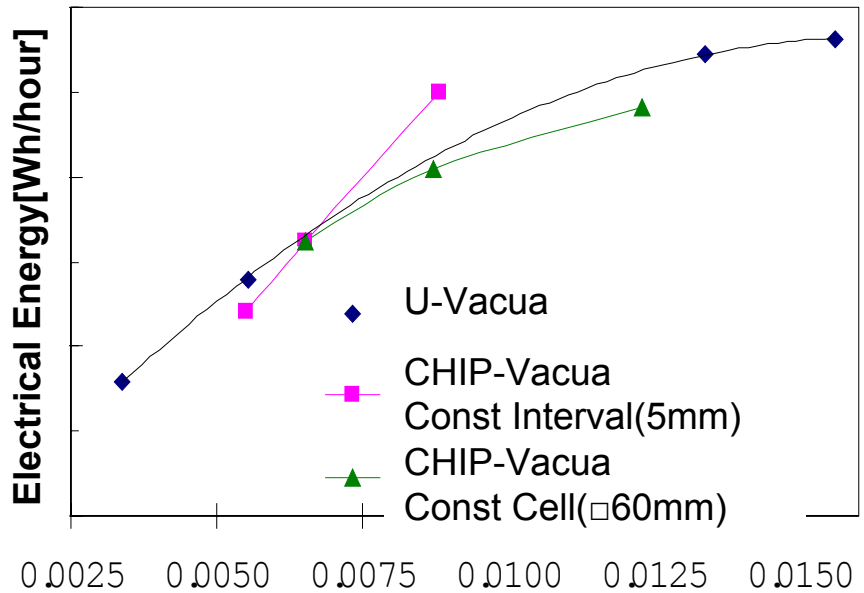
■**Inspection**

Insulation Effect to Applied Object by Various Type of CHIP-Vacua

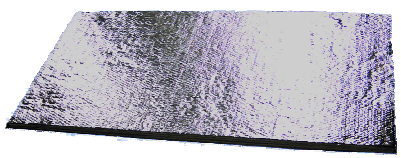
□Applied Object(Electrical Thermo Pot)



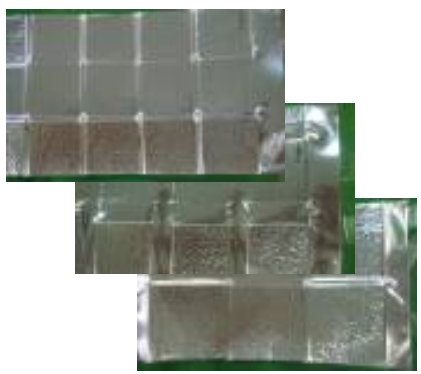
□Result



□Applied VIP



U-Vacua (5mm^{t})



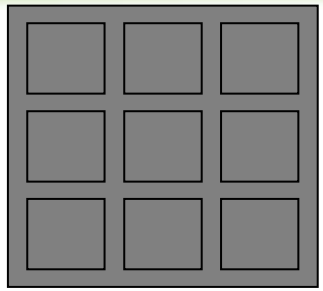
CHIP-Vacua (5mm^{t})

Almost The Same Insulation Effect as U-Vacua,
Assuming Sealed Parts=Static Air (0.0250W/mK)

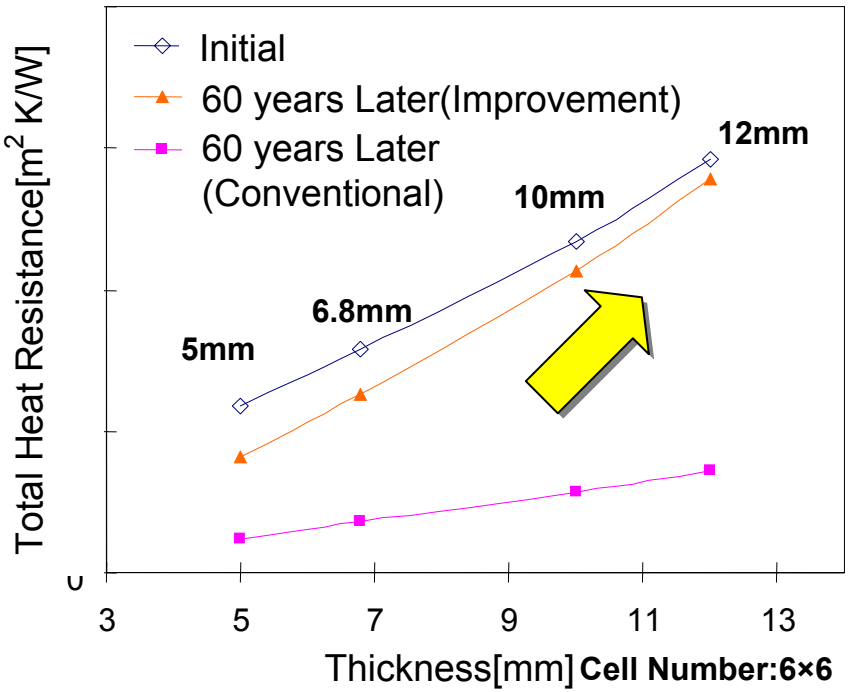
Long Time Reliability

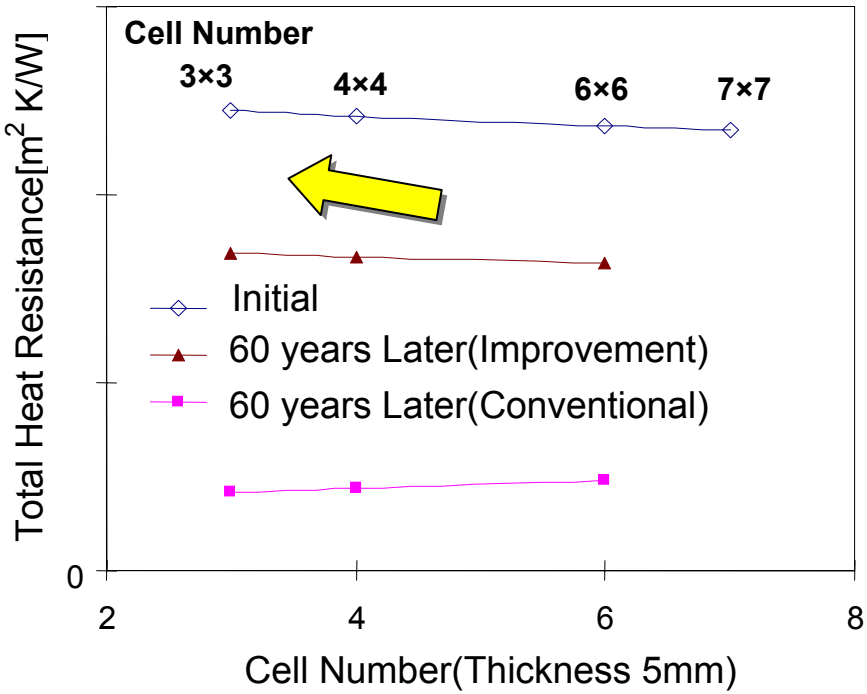
■Calculation Condition

- **Thermal Conductivity(Cell Part)**:0.0020W/mK
- **Size**:910mm*910mm*5mm^{t}
- **Improvement Plan(60 years later)**:Effective Cell Pattern & High Gas Barrier Film



Ex:Cell Number 3×3



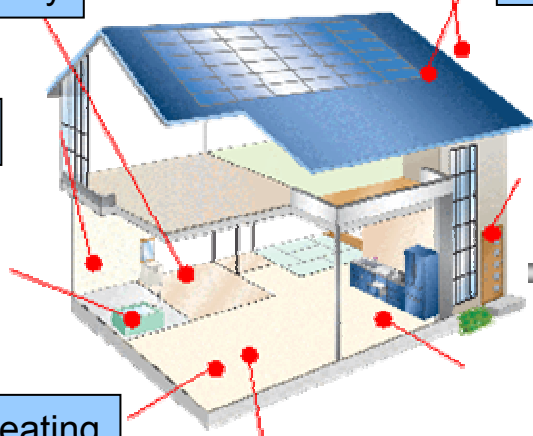


Improving Factor for Reliability

---1.Thickness UP , 2.Decreasing Cell Number

Application Example

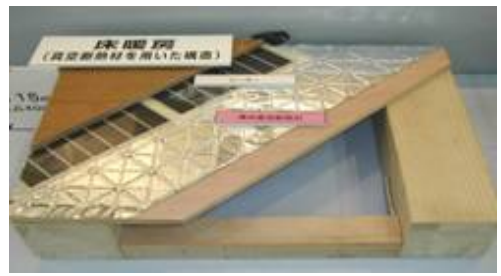
Housing



Hot Water Tank

Easy Handling

Reliable Construction
able to cut, drive nails



maintain high performance in construction site

Insulation Material

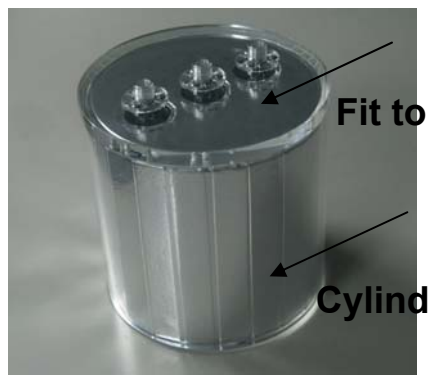
Winter Wear

bedclothes

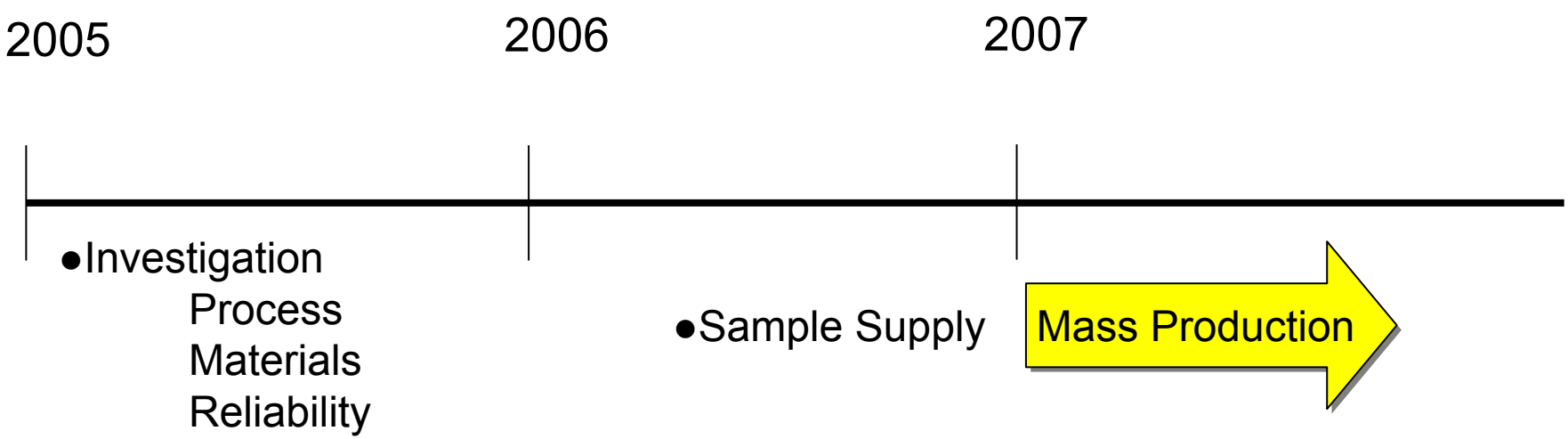
Carpet

Blind

Flexible Shapable



Development Schedule for CHIP-Vacua



●Now under Investigation for Mass Production
●Starting of Mass Production in 2007
Sample Supply(2006)

***Price Undecided**

Reference

Application to Winter Wear

CHIP-Vacua(3mm^{t})

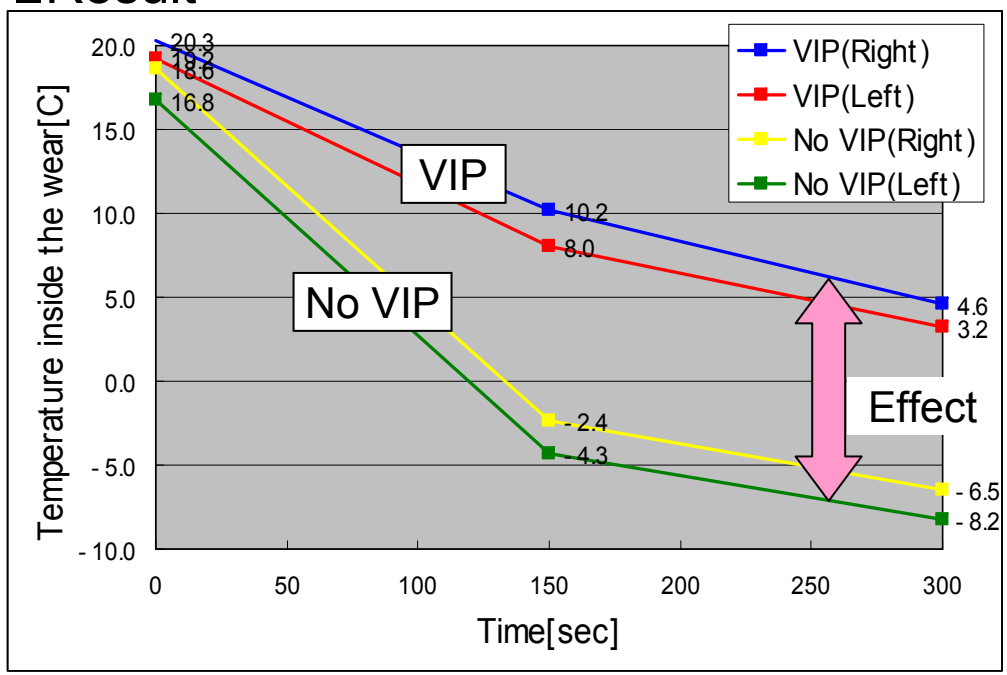
■Method

1.Wearing this Wear at –10□

2.Measuring Temperature inside the wear

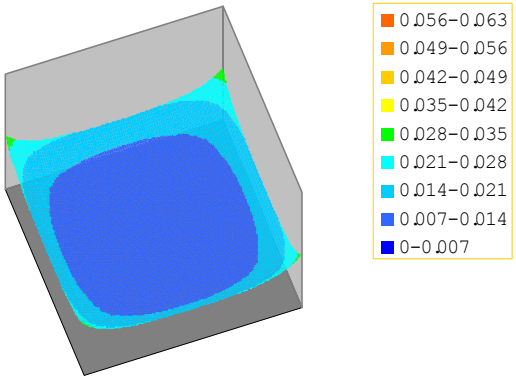
Measurement Point:Right and Left Chest

■Result



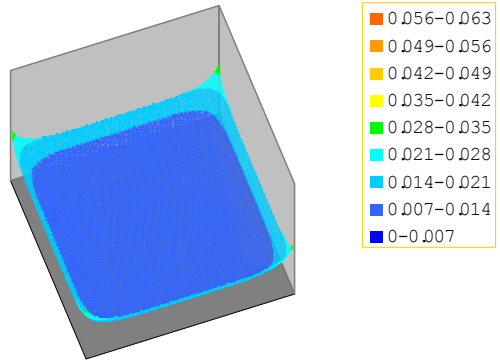
Decreasing the Heat Bridge

■Distribution of Thermal Conductivity Considered Heat Bridge (Hot Temperature Side)



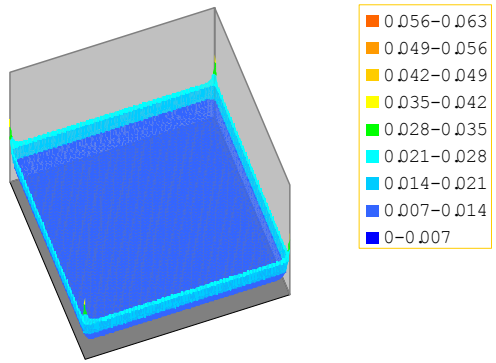
Aluminum Laminated Film
Core Material : □100mm

Making Cell Size Larger



Aluminum Laminated Film
Core Material : □200mm

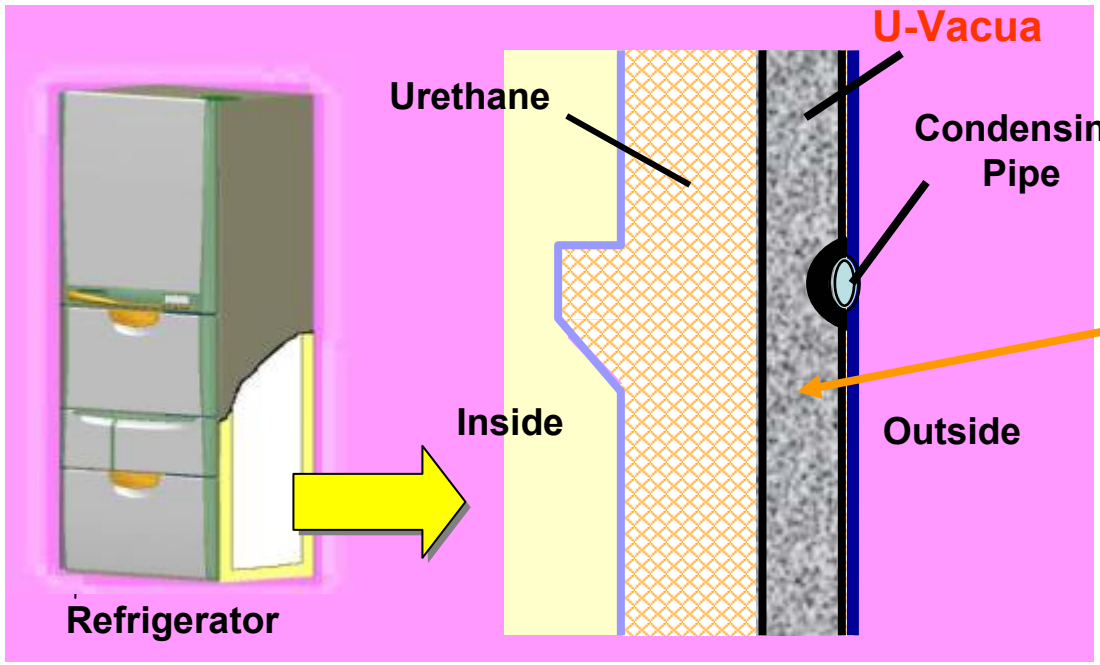
Changing Film



Aluminum Vapor Deposition Film
Core Material : □100mm

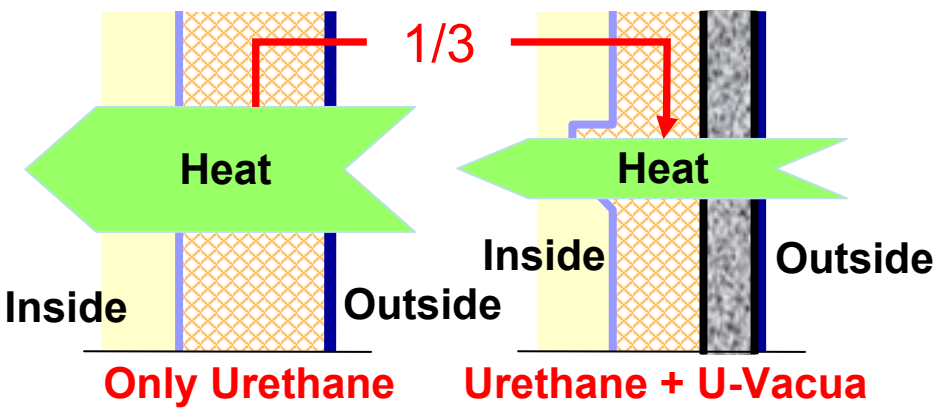
Point for Decreasing Heat Bridge 1.Large Cell Size, 2.Low λ Film
---Optimization of Cell Pattern for Each Application

U-Vacua Application to Refrigerator



Groove on the surface

Reducing Heat Transfer



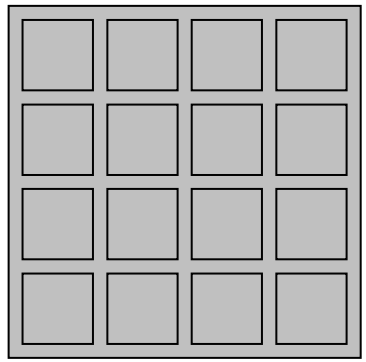
Points for U-Vacua Application

- High Insulation Property(0.0020W/mK)
- Large Covering Ratio
- Covering on Condensing Pipe

Contribution to Energy Saving

Investigation of Aluminum Crack

■Method---Detecting the Aluminum Crack on VIP Film
by observing transmitting light

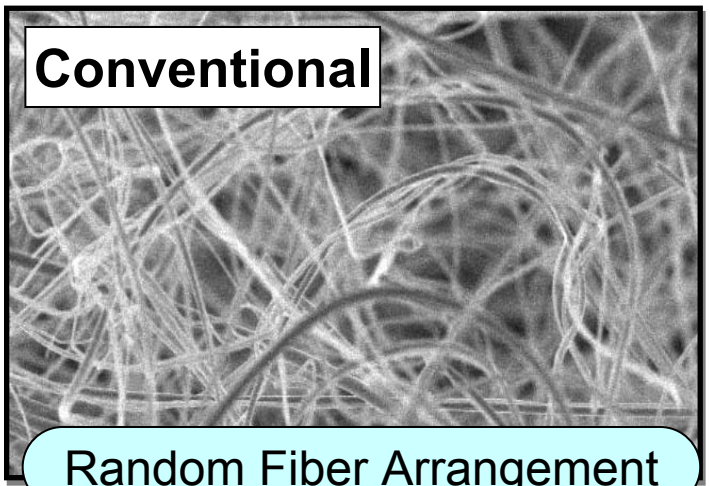


■Result---Number of Generated aluminum Crack [number/m^2]

	AL Foil	AL Vaporization
Conventional Technology	Secret Data Under Investigation	
CHIP Technology		

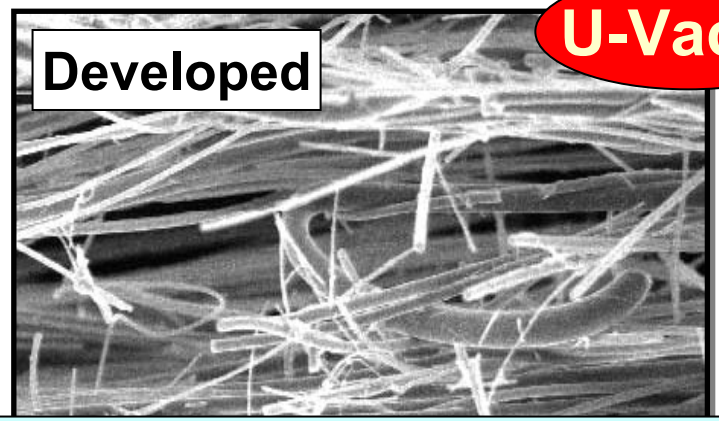
No Deterioration as to AL Crack in CHIP Technology

Hyper Insulation Technology, "FLAT"



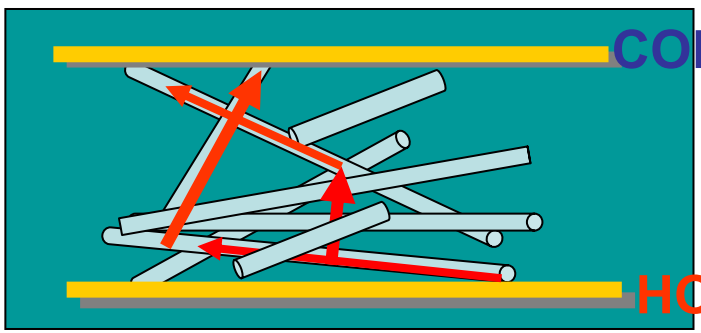
Random Fiber Arrangement

Core Material (Fiber)

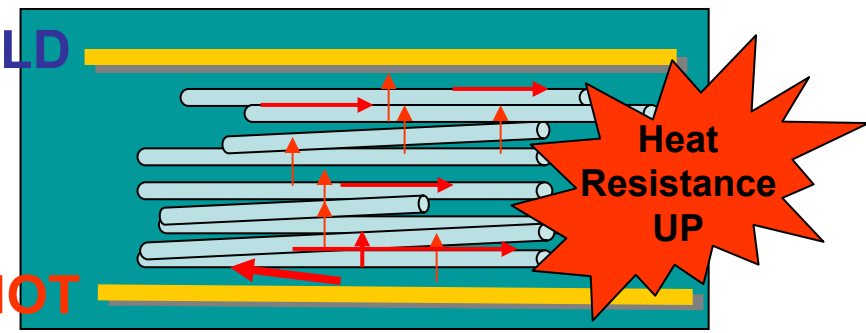


U-Vacua

Fiber Layer Arrangement Technology



Heat Transfer Model



Thermal Conductivity

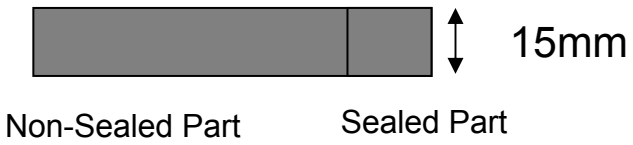
0.0040	W/mK	Solid	0.0015	W/mK
0.0005	W/mK	Gas	0.0005	W/mK
0.0045	W/mK	Total	0.0020	W/mK

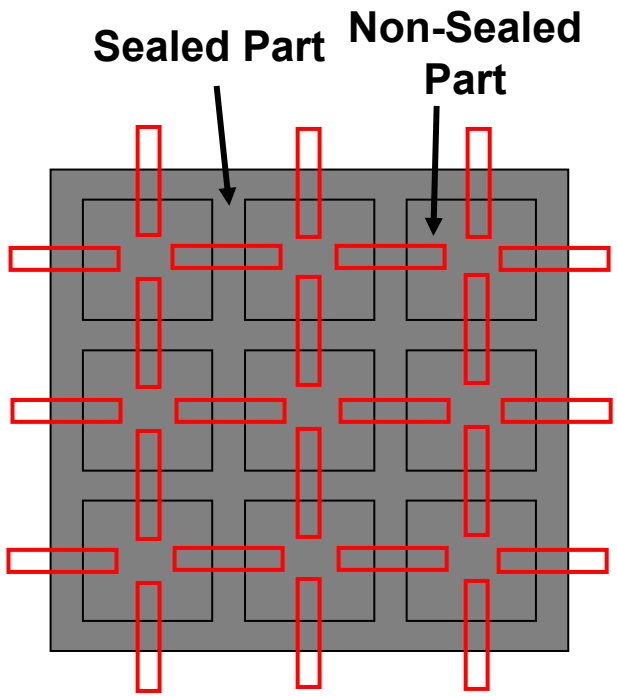
Sealing Intensity

■Method

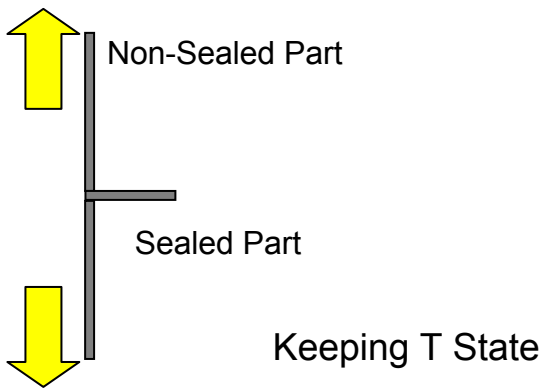
1.Cutting a part of VIP including sealed and non-sealed Part

Cut Size:Width15mm(Length:Any)





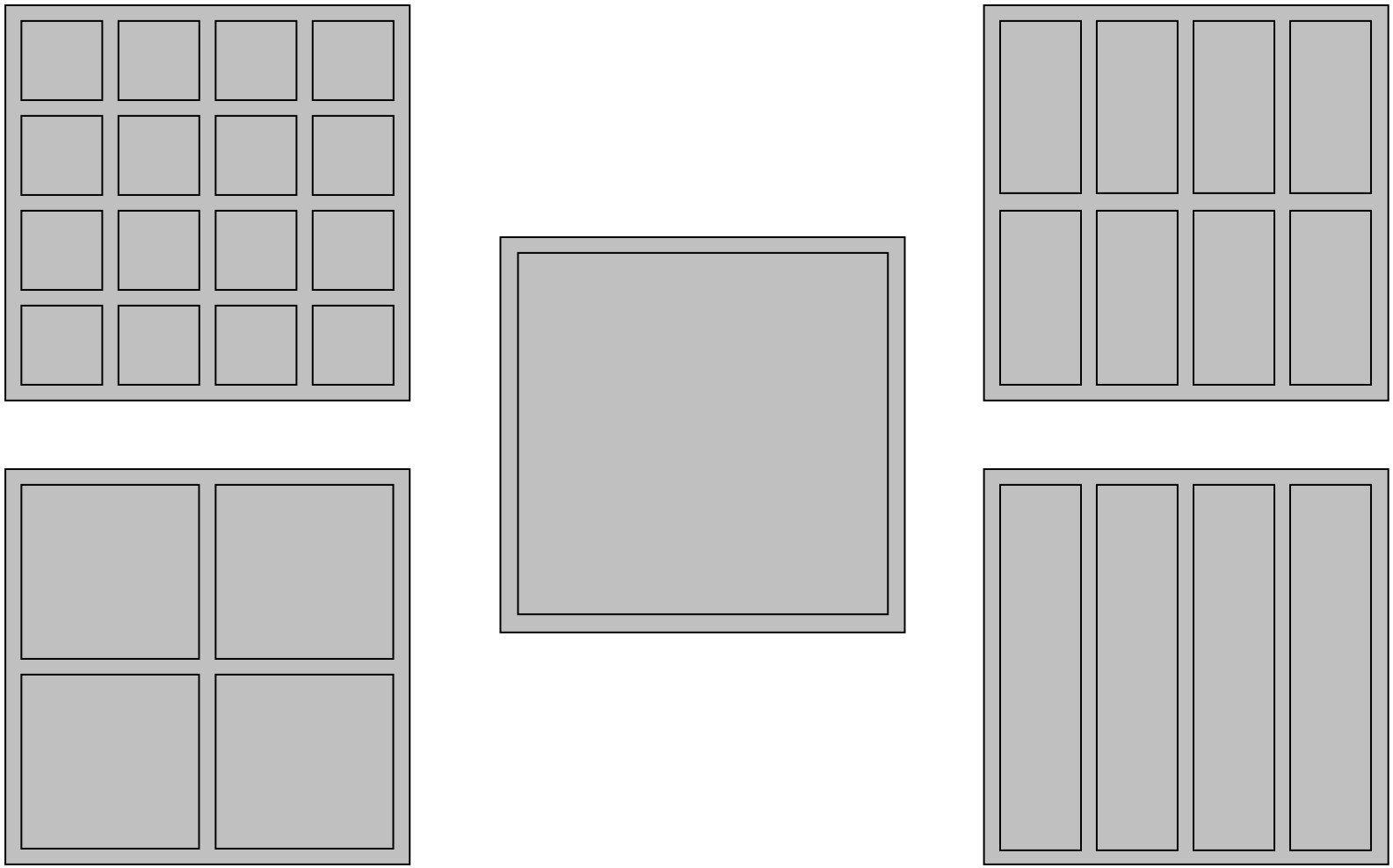
2. Pulling the Part at 100mm/min



Sealing Intensity:Force at Tearing the Film

Enough Sealing Intensity is Secured in CHIP Technology
(More Than 70N/15mm)

Arranging Cell Pattern



Insulation Property, Reliability, Applicability depend on Pattern
---Under Investigation for Optimization of Pattern

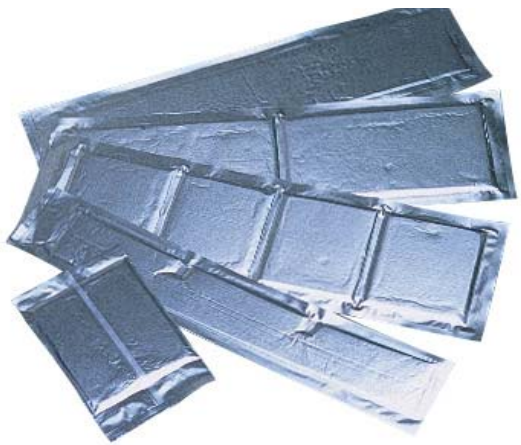
Processing Example of Vacua

Flat

Box

Cylinder

Groove
On Surface



Vacua can be Processed to Various Type

Table for Vacua Line-Up

Vacua

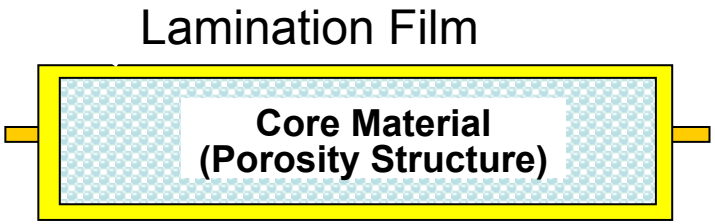
VIP's Name Panasonic Produces

Vacuum adiabatic cure the atmosphere

	Powder Type		Fiber Type	
	Silica	A-Vacua	S-Vacua	U-Vacua
Thermal Conductivity [W/mK] at 24□	0.0080	0.0050	0.0045	0.0020
Applicable Temperature Range[C]	-40~105		-40~60	
Length[mm]	20□685		20□800	20□1500
Width[mm]	20□210		20□400	20□500
Thickness[mm]	4□15		3.5□24.5	10□12
Density[kg/m^3]	200	130	200	220
Application	For high temp:Thermo Pot etc.		For low temp:Refrigerator etc.	

Structure & Technical Point

■Structure



Vacuum Degree□1□200Pa

Similar Performance like Thermo Pot
by Low Vacuum Degree

■Technical Point

λ□□□□□= λ□+λ□+λ□+λ□

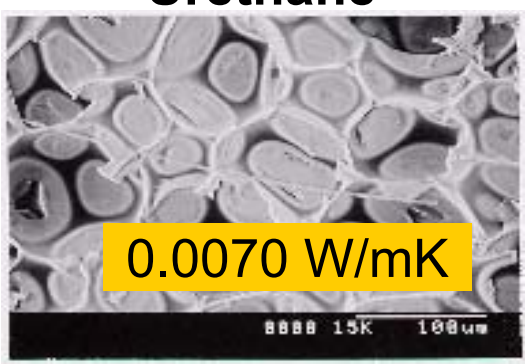
□□□□ □□□□

●Air Space Over 90.
Forming Vacuum Space

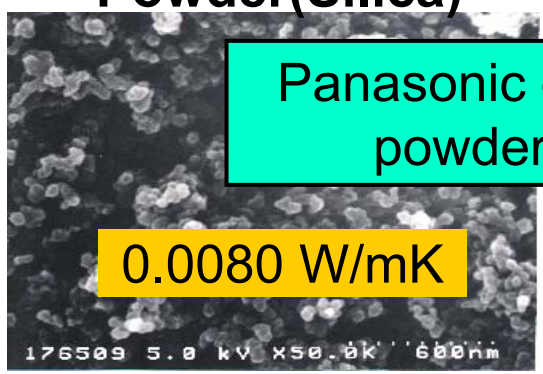
●Heat Resistance Up
by Core Point Contact Connection

Typical Core Materials

Urethane



Powder(Silica)



Fiber(Glass Wool)