

# Forward Endcap Issues

Thomas Held

Ruhr-Universität Bochum  
Institut für Experimentalphysik I

LIII. PANDA Collaboration Meeting, Uppsala  
June 9th, 2015

RUHR  
UNIVERSITÄT  
BOCHUM

**RUB**



# Forward Endcap Thermal Insulation

- VIPs (Vacuum Isolation Panels):  
"Vacupor NT" made by Porextherm
- Operating temperatures:  
 $-50\text{ }^{\circ}\text{C} < T < 120\text{ }^{\circ}\text{C}$
- Thermal conductivity (@ 22.5 °C):
  - $\leq 0.005\text{ W/mK @ 1 mbar}$
  - $\leq 0.019\text{ W/mK @ ambient pressure}$
- VIPs covered by thin aluminum layer (about 200 nm)
- Insulation thickness of 20 mm is foreseen, limited by available space



## Vacupor® NT

### Characteristics

Vacupor® NT is a microporous insulation material with an extremely low coefficient of thermal conductivity, i.e. with very good insulating properties. Vacupor® NT consists of inorganic oxides. The main constituent is fused silica, the other components are opacifiers for minimizing infrared radiation, and silicates.

Vacupor® NT (core material) is not flammable and meets the requirements of IMO FTPC part 1 and DIN ISO 4102 part 1, A1.

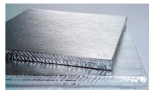
Vacupor® NT is heat sealed in a metallized, multilayer plastic film under vacuum. The very low internal pressure and the microporous panel core is responsible for the extremely low thermal conductivity values.

### Application

Vacupor® NT was specially developed for applications in vacuum insulation technology. The low density and the specially developed IR opacifiers contained in these grades greatly reduce the thermal conductivity of Vacupor® NT Systems.

Vacupor® NT is also successfully used as insulation material in the following areas:

- Domestic appliances (refrigerator and freezer cabinets)
- Absorption refrigerators
- Cryogenic freezer
- Temperature controlled packaging
- Transport boxes
- Facade elements
- Terrace insulation
- Cold storage floor insulation
- Tank container insulation



### Form of delivery

#### 1. Standard sizes:

- 600 mm x 250 mm
- 1000 mm x 300 mm
- 600 mm x 500 mm
- 1200 mm x 500 mm
- 1000 mm x 600 mm
- 1200 mm x 1000 mm

#### 2. Standard thicknesses:

- 10 mm, 15 mm, 20 mm, 25 mm, 30 mm
- Further thicknesses on request

#### 3. Special formats available on request

### Restrictions on Applications

The metallized, multilayer plastic film of the Vacupor® NT must not be damaged by drilling, cutting, milling, nailing or the like, since the interior pressure of the panel will rise and the special properties of the panel, in particular its excellent insulation characteristics, will be lost.

### Shelf life

Vacupor® NT has a very long shelf life. Please also observe our pressure rise table: Thermal conductivity as a function of interior pressure.

### Composition

Silicon dioxide	SiO <sub>2</sub>	approx. 80%
Silicon carbide	SiC	approx. 15%
Others		approx. 5%

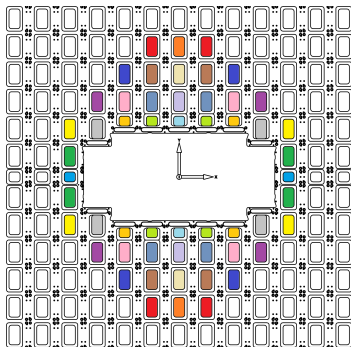
# Forward Endcap Thermal Insulation

- Two layers of 10 mm VIPs each in order to be able to cover glue joints in one layer by the other layer (avoiding thermal bridges)
- For maintenance and repairs, front and back insulation will be attached in a removable manner
- There are 36 cable feedthrough openings in the “electronics frame”, which need to be insulated individually
- All insulation puzzle parts finalized now



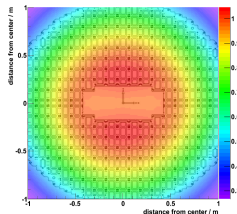
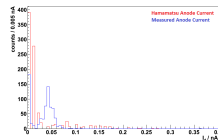
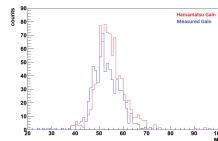
# VPTTs - Distribution of Tubes

- Measured 774 of 900 delivered tubes yet



- M=58.0-59.5
- M=59.5-60.0
- M=60.0-61.5
- M=61.5-62.5
- M=62.5-63.0
- M=63.0-64.0
- M=64.0-65.0
- M=65.0-66.0
- M=66.0-68.0
- M=68.0-69.5
- M=69.5-70.0
- M=70.0-71.0
- M=71.0-72.0
- M=72.0-72.5
- M=72.5-76.5
- M=76.5-84.5

- Symmetric tube arrangement according to symmetric magnetic field strength in forward endcap
- Resulting tube gains (@ 1 kV) with full magnetic field strength: 25-31



## HV-Divider VPTT

what's new in 2015 (Type SP883d\_HV\_1.5kV) :



- PCB-material FR4 (epoxy/glass): Panasonic R-1551W  
(flammability UL94-V0, halogene free/non corrosive)
- Solder resist: IPC 6012C Class 3 (lower leakage current)
- Leakage resistance (CTI): 500 (V/0.5mm)

Note: Standard FR4 material has a comparative tracking index of >175V, extra leakage resistant variants have a CTI of >400V up to >600V

- Pads: gold plated (less electro-migration)
- 4n7, 1500V, X7R Capacitors: Kemet C1206C472KFRAC7800  
(higher voltage)
- Solder: 60Sn/40Pb (low temperature reliability, less whisker)
- Assembly: Keep more distance/proper position to  
components on motherboard (Preamp)!**
- Careful handling, dry storing, soldering (use only  
60Sn/40Pb), residue cleaning and coating required!**

# VPTTs - Basel Preamp



Obsolete 1 kV voltage dividers perfect as shopping cart coins!

"We Want Panda!"

Uni Bochum

Wir wollen!

Panden!



Die machen	Emma
mit	Jannis
Joana	Dilara
Leah	Laurie ☺
marilka	Obi