

# Production of thin-gap Resistive Plate Chambers (RPCs)

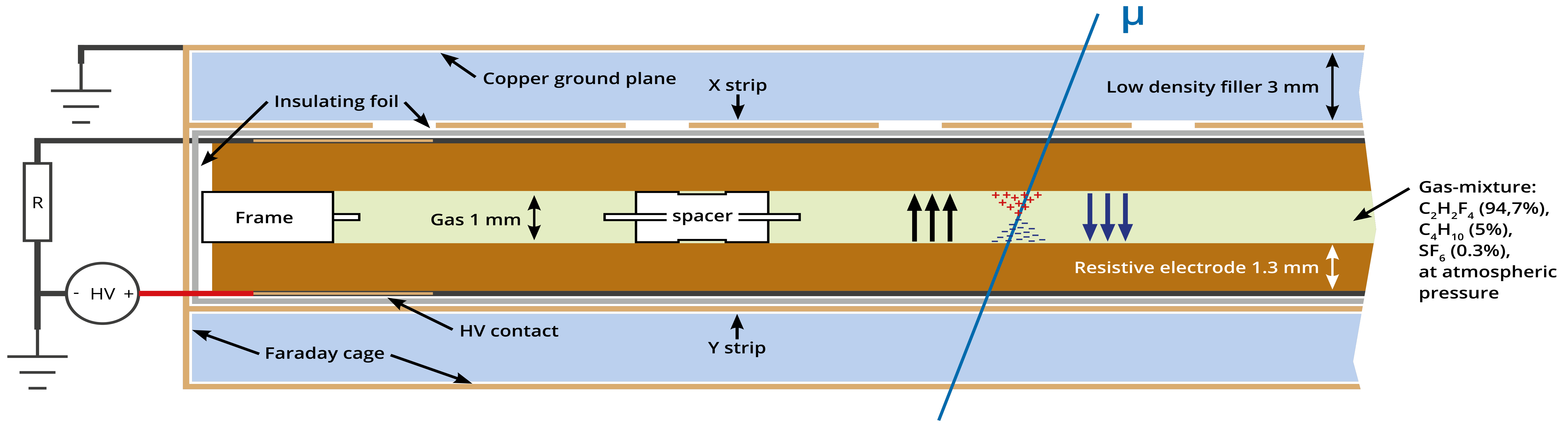
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Resistive plate chambers (RPCs) with electrodes of high-pressure phenolic laminate (HPL) are a well established technology for the instrumentation of muon systems at high-energy particle colliders. The gap between the HPL plates (electrodes) is defined by spacers and frame profiles made of polycarbonate. The outer surfaces are covered with sheets of polyethylene terephthalate PET.

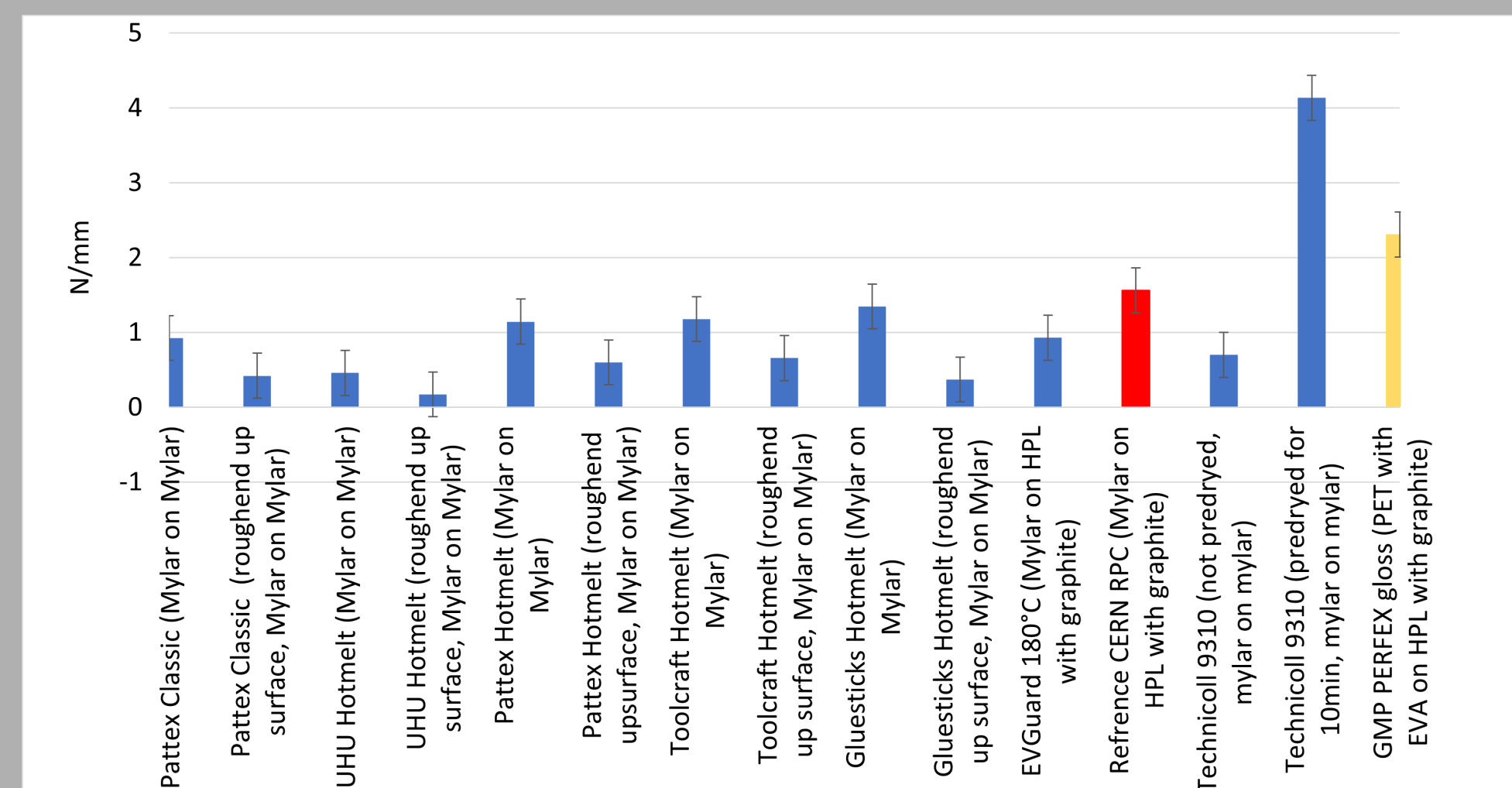
It is known that PET foils are difficult to glue as most of the glues used for plastics can be easily ripped off the PET surface. We therefore compared different types of glues, ranging from EVA hotmelts to special glues for PET foils, regarding the quality of the glue bond and their outgassing properties.

At the moment there is only one certified producers for HPL plates that is able to provide plates with the required resistivity. We started a search for alternative suppliers of the HPL plates providing first samples with resistivity close to the required range.



## Glue tests

Goal: identify hot-melt glues which have a good adhesive strength on the PET foil and the graphite coated HPL surface. Adhesive strength was measured by measuring the force necessary to rip the glued PET foil from either from another PET foil or a graphite coated electrode.



Two alternatives for the reference glue found with even higher adhesive strength.

Both have a processing lower than 110°C

Technicoll:

- not EVA but polymeric glue
- needs to be certified for use in RPCs in aging-test

Attractive alternative GMP PERFEK gloss (PET compound foil with EVA pre-applied):

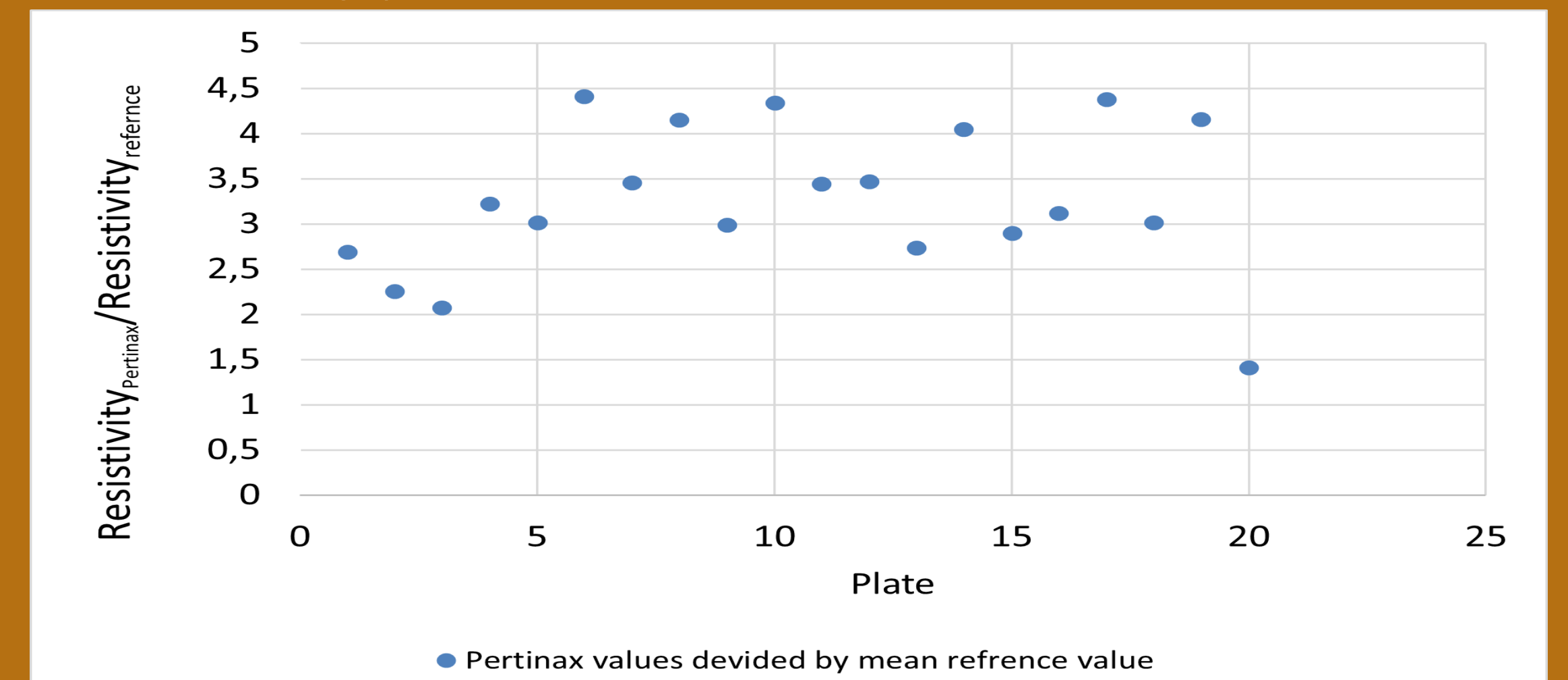
- Foil laminated to electrode under pressure at 105°C for 1h



## Search for a alternative supplier of HPL-electrodes

Reference: 1,3 mm thick HPL plates from Teknemika (certified manufacturer for ATLAS-RPCs)

Alternative: 1 mm thick Pertinax HPL plates from Müller-Alhorn (part of their assortment range)



Volume resistivity of Pertinax plate is of the same order of magnitude as of the reference plates.

-> RPCs produced with these plates:

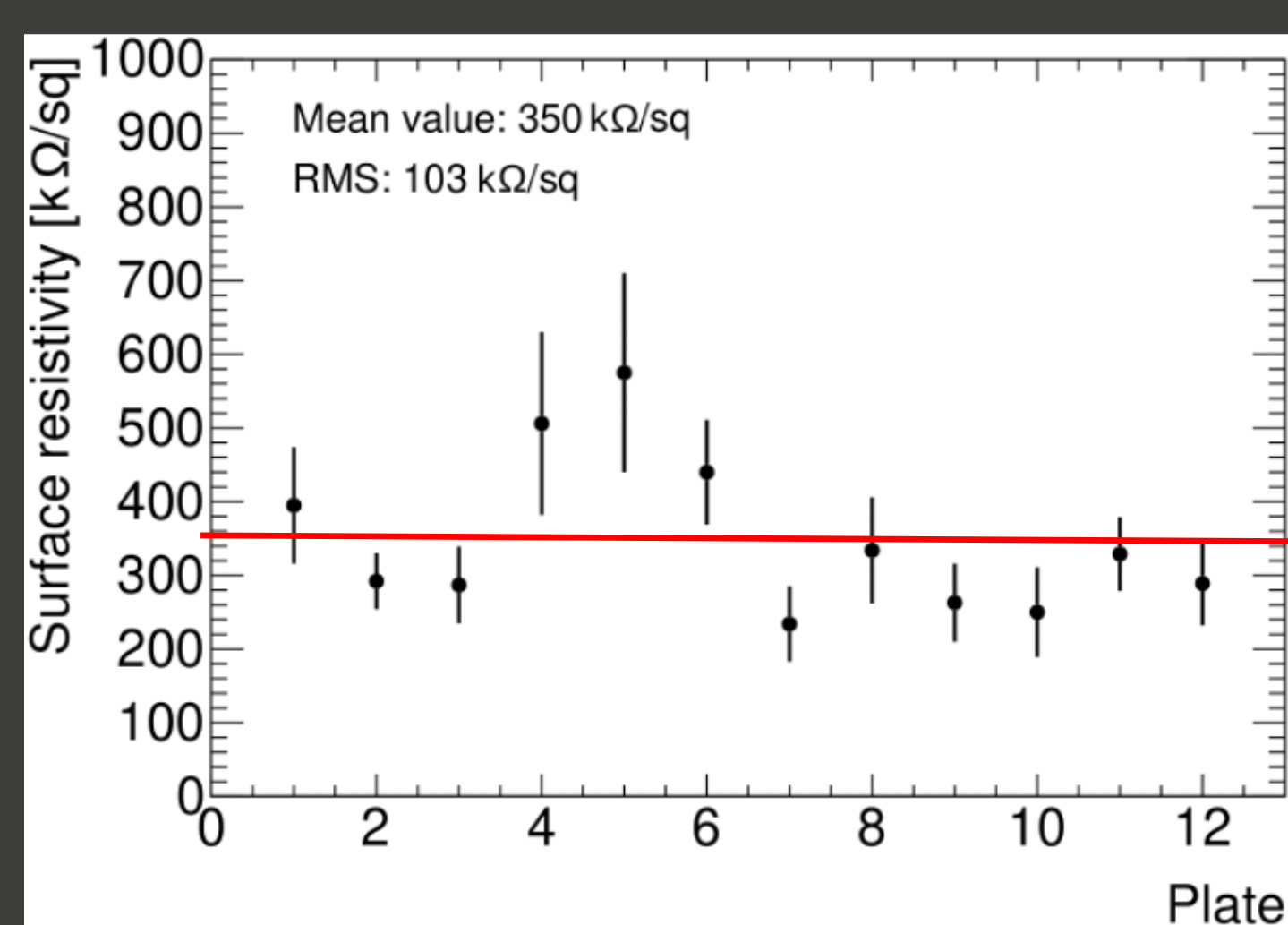
- initially functional
- developed voltage instability
- cause of this under investigation

Next step: manufacturer to produce new plates custom made 1.3 mm thick plates with volume resistivity of  $1.5 \times 10^{10} \Omega \cdot \text{cm}$  (ATLAS specifications).

## Graphite coating

Best reproducibility of coating achieved by silkscreen coating:

- mesh-width: 80 threads/cm
- graphite varnish supplied by Heysung trade company
- plates left to dry for 5 days after the printing



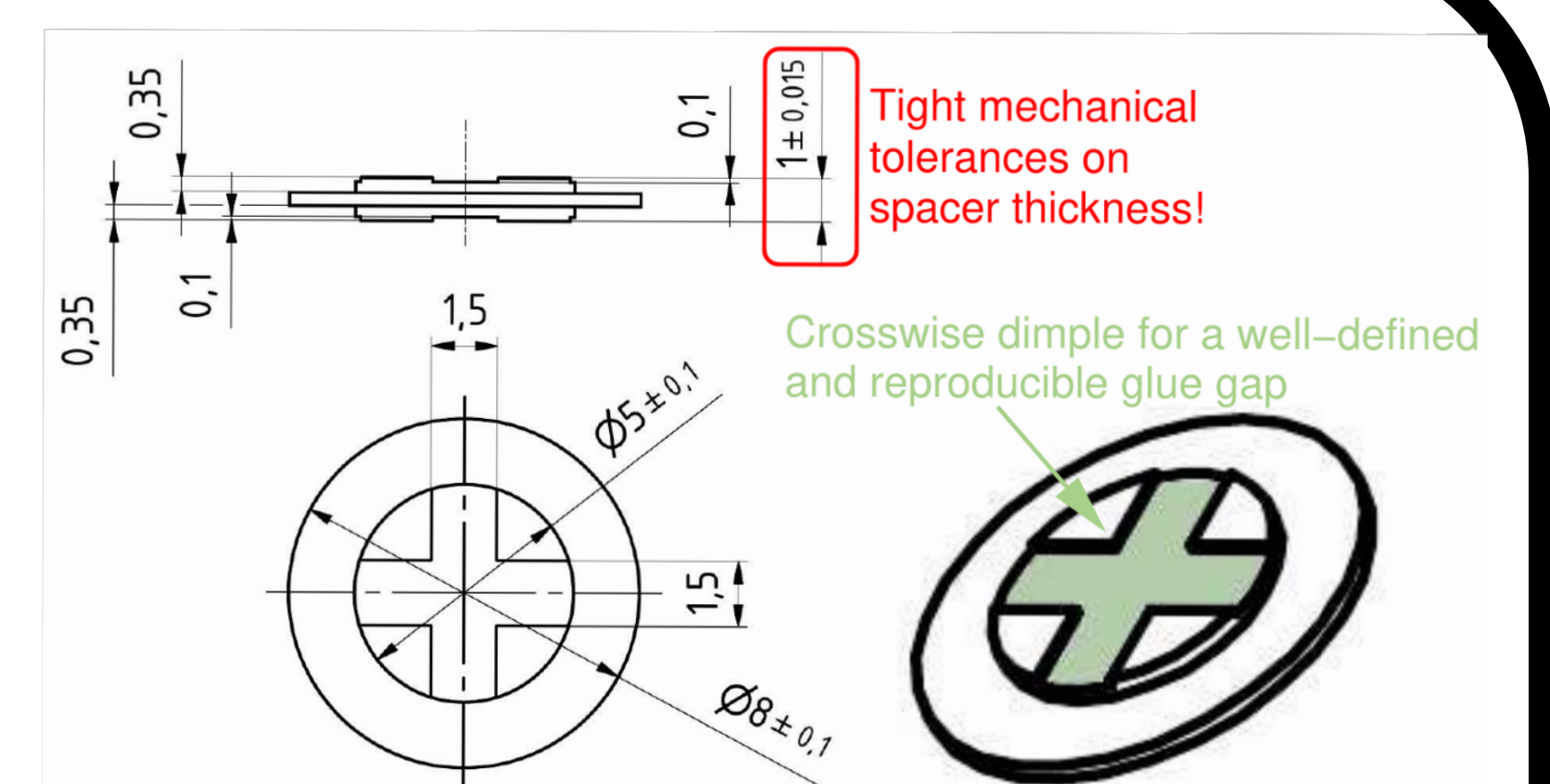
Commercial device for the measurement of high ohm measurements according to DIN norm



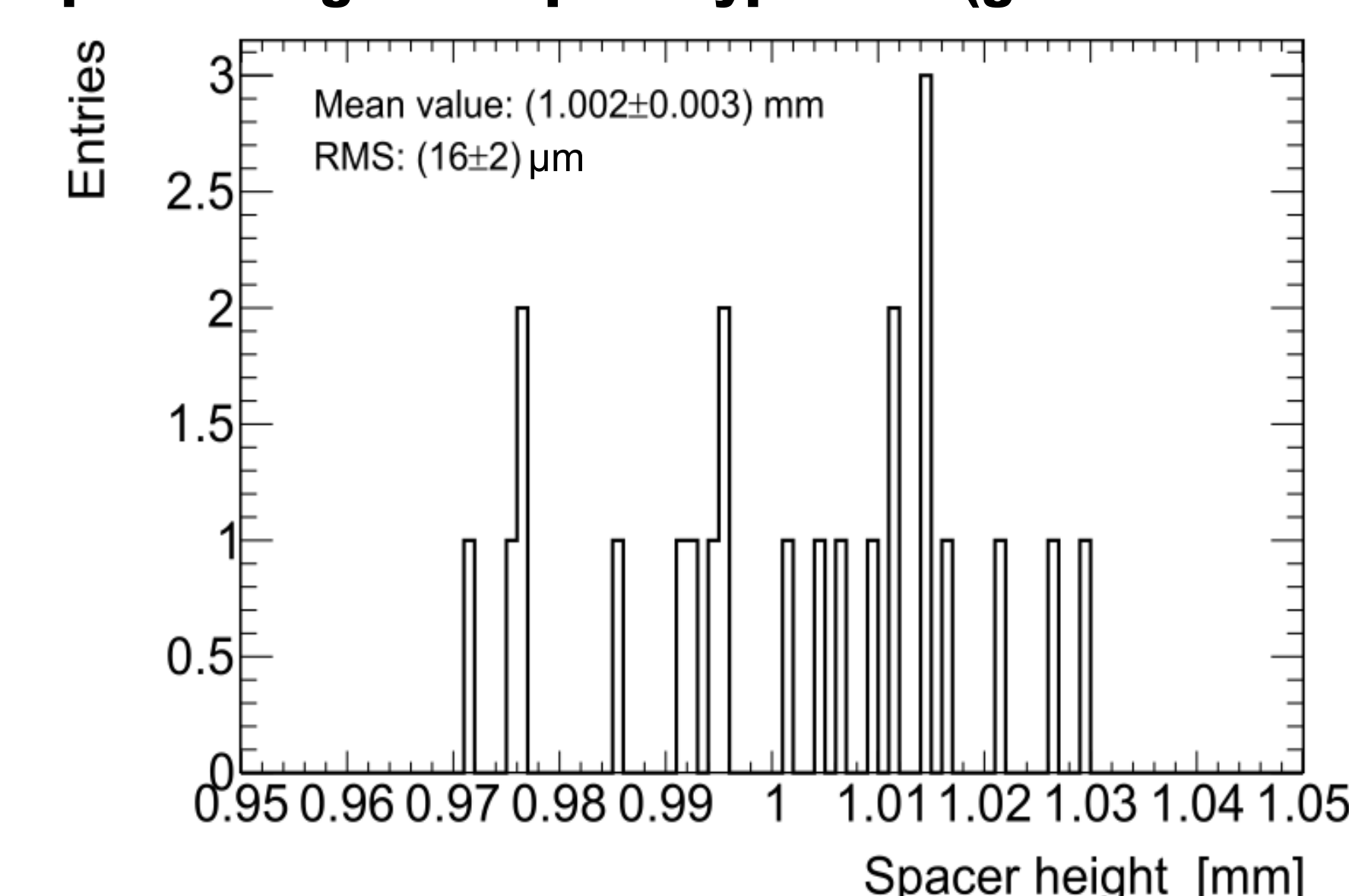
This procedure provides the necessary resistivity of  $350 \text{ k}\Omega/\text{cm}^2 \pm 30\%$

## New spacer design

Improved in order to achieve well reproducible glue gap. Manufactured by injection molding.



## Spacer height in a prototype RPC (glued to HPL plate)



Target of spacer height after gluing to HPL electrode of  $1.000 \text{ mm} \pm 15 \mu\text{m}$  achieved