Workshop on Bonding Technologies

ACF bonding tests for the ALICE TRD signal cables

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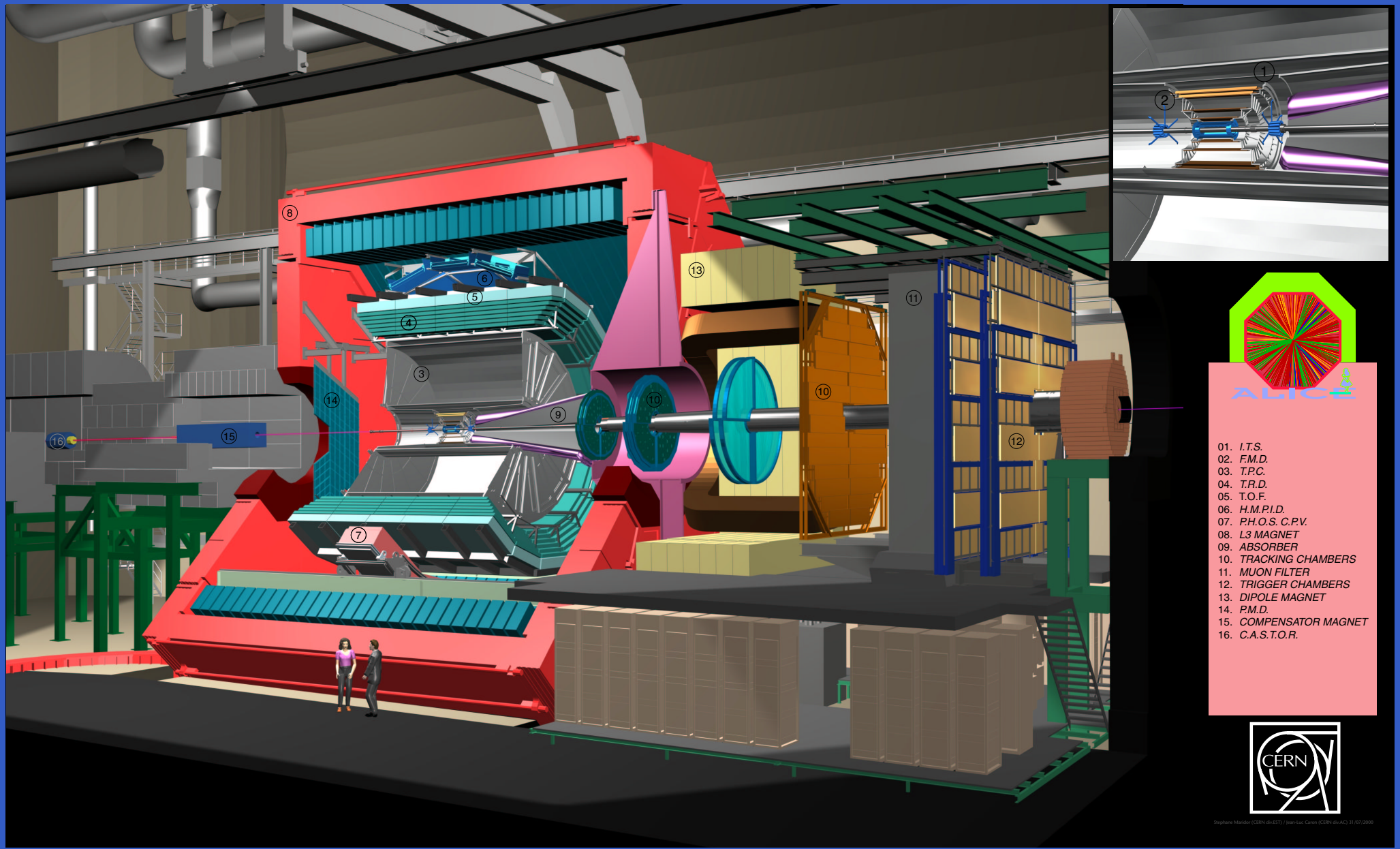
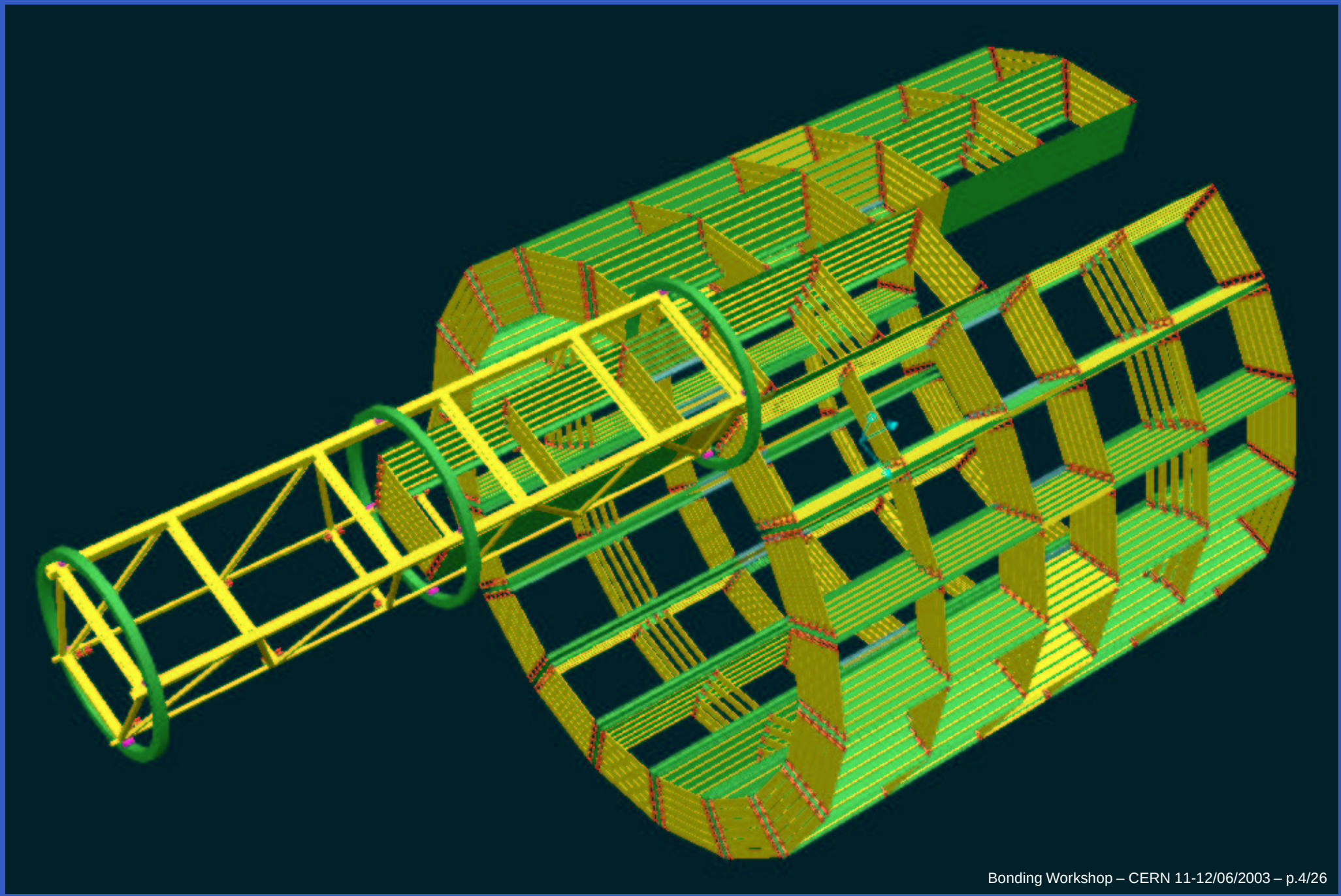
The ALICE TRD

The ALICE detector



The TRDetector



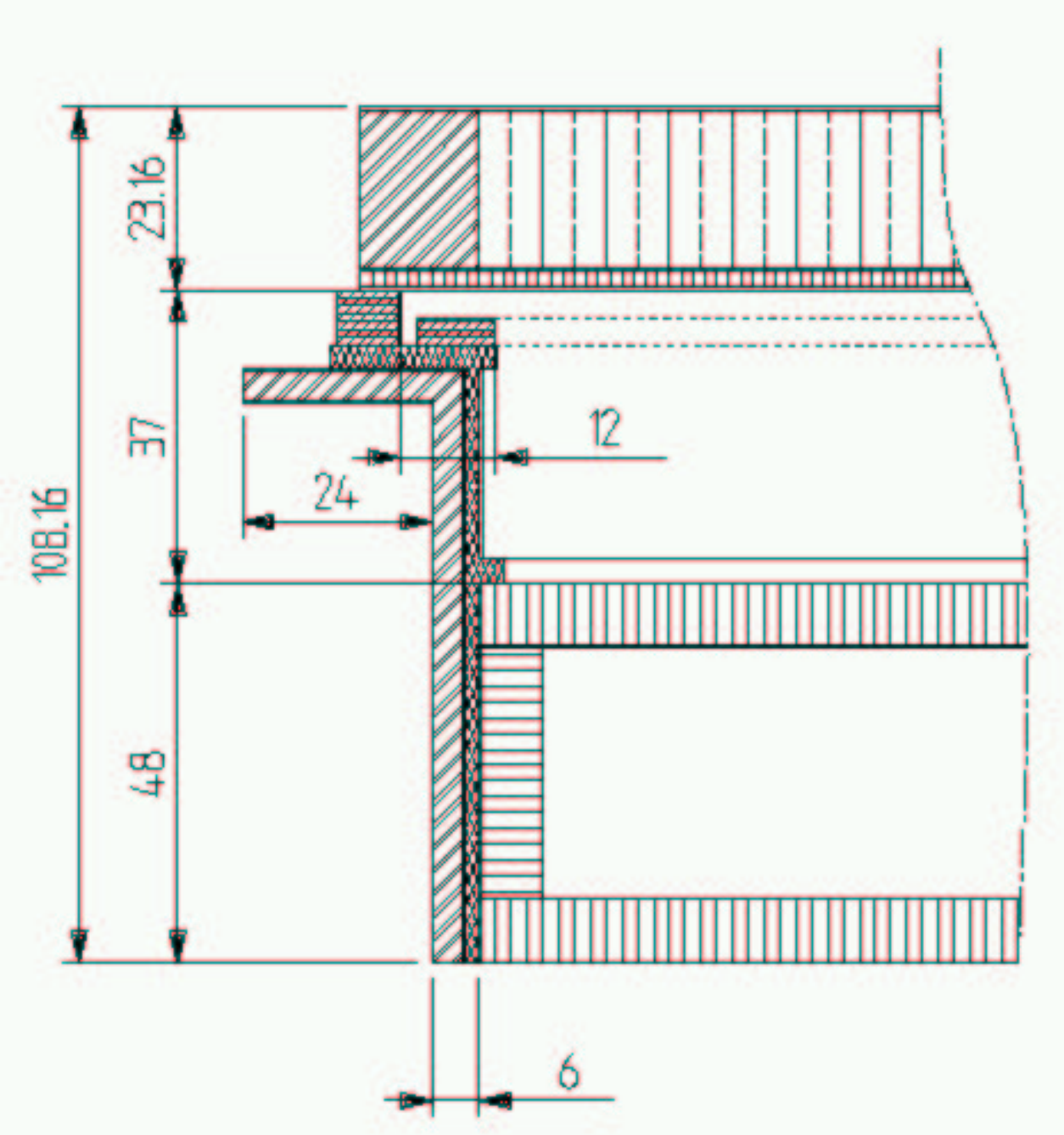
The TRD in numbers

The ALICE Transition Radiation Detector

- has 540 chambers of 12 different types
- covers 746 m^2 area
- offers close to 1.2 million readout channels
- will be the world's biggest TRD

The TRD readout chamber and pad plane

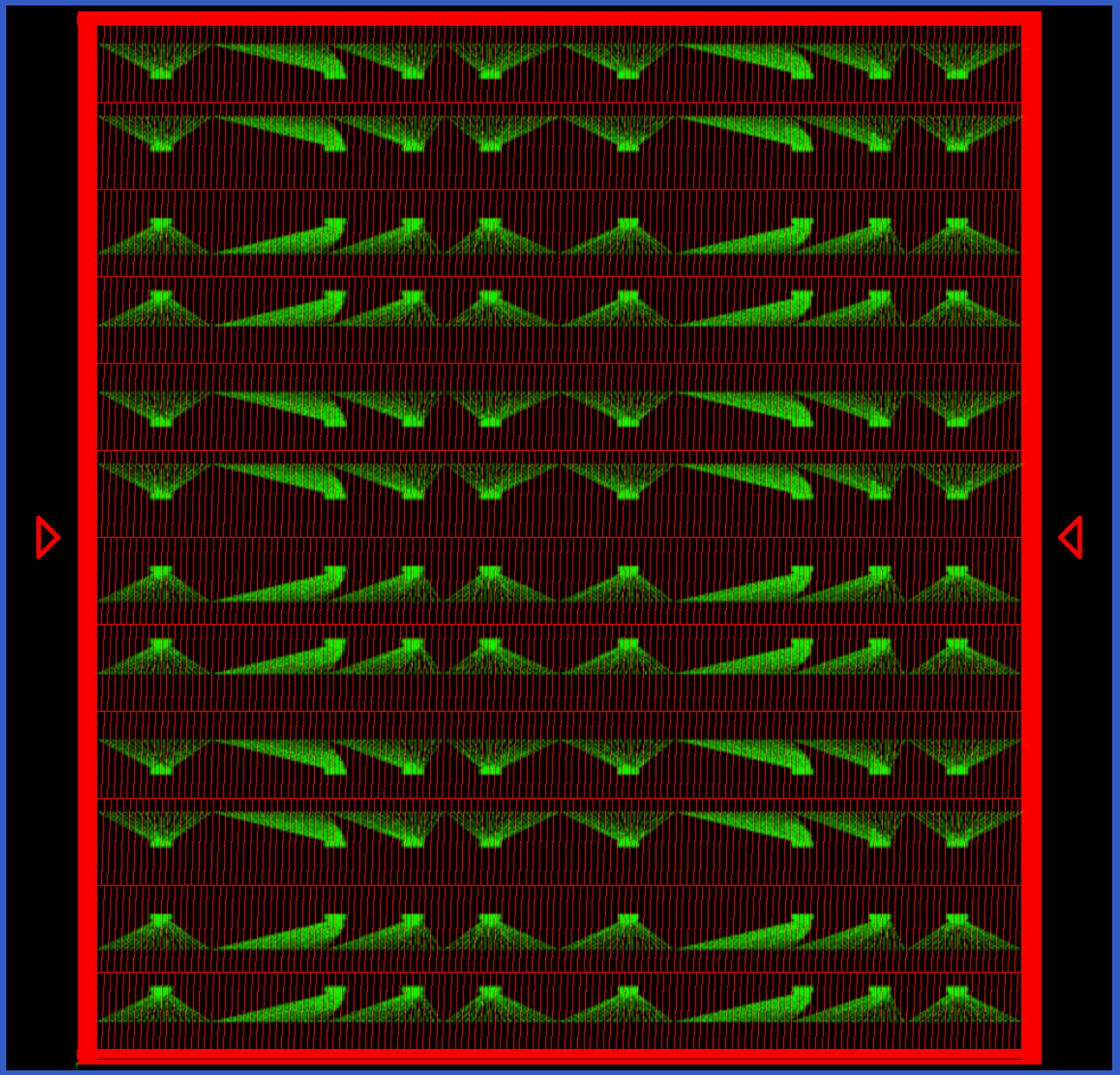
Xsection of a TRD Read Out Chamber



ROC and pad plane

- ROCs are to big to produce pad planes out of one single piece
- maximum pad plane manufacturing size :
  1225 mm x 580 mm
- full TRD pad plane is divided into 1512 single pieces
- pieces range from 996 mm x 300 mm
  to 1218 mm x 550 mm
- pad plane material :
  360 μm thick halogen free FR4,
  17 μm Cu on both sides

A TRD pad plane



The TRD signal cable

Requirements

- cable connects pad plane to readout board electronics
- full TRD has 65664 signal cables
- cable should be fixed directly onto the pad plane, avoiding usage of connectors there
- big number calls for a reasonably cheap solution

Cable design

pad plane side

bonded

readout board side

connector

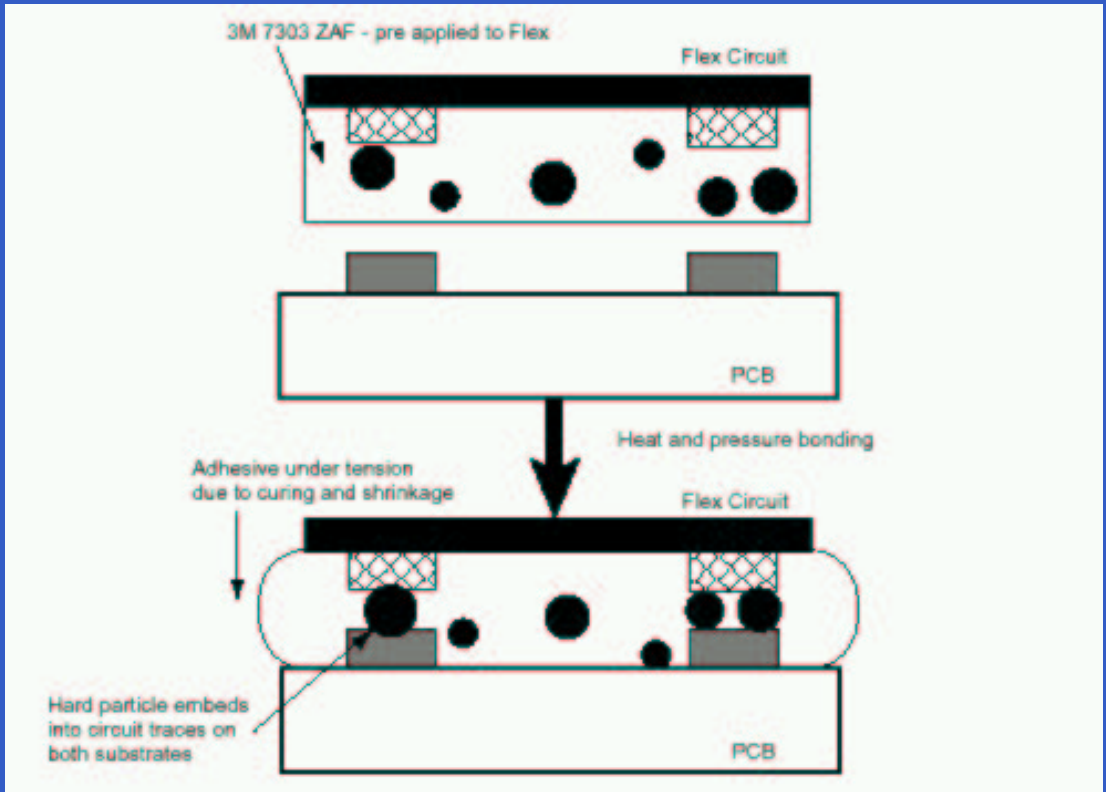
Cable properties

- 22 traces
- 23 mm width
- 60 mm length
- 35 μm thickness
- material : capton - copper - capton
- bonding gold on both ends
- bonding footprint : 6 mm x 0.6 mm pads, gap 0.4 mm

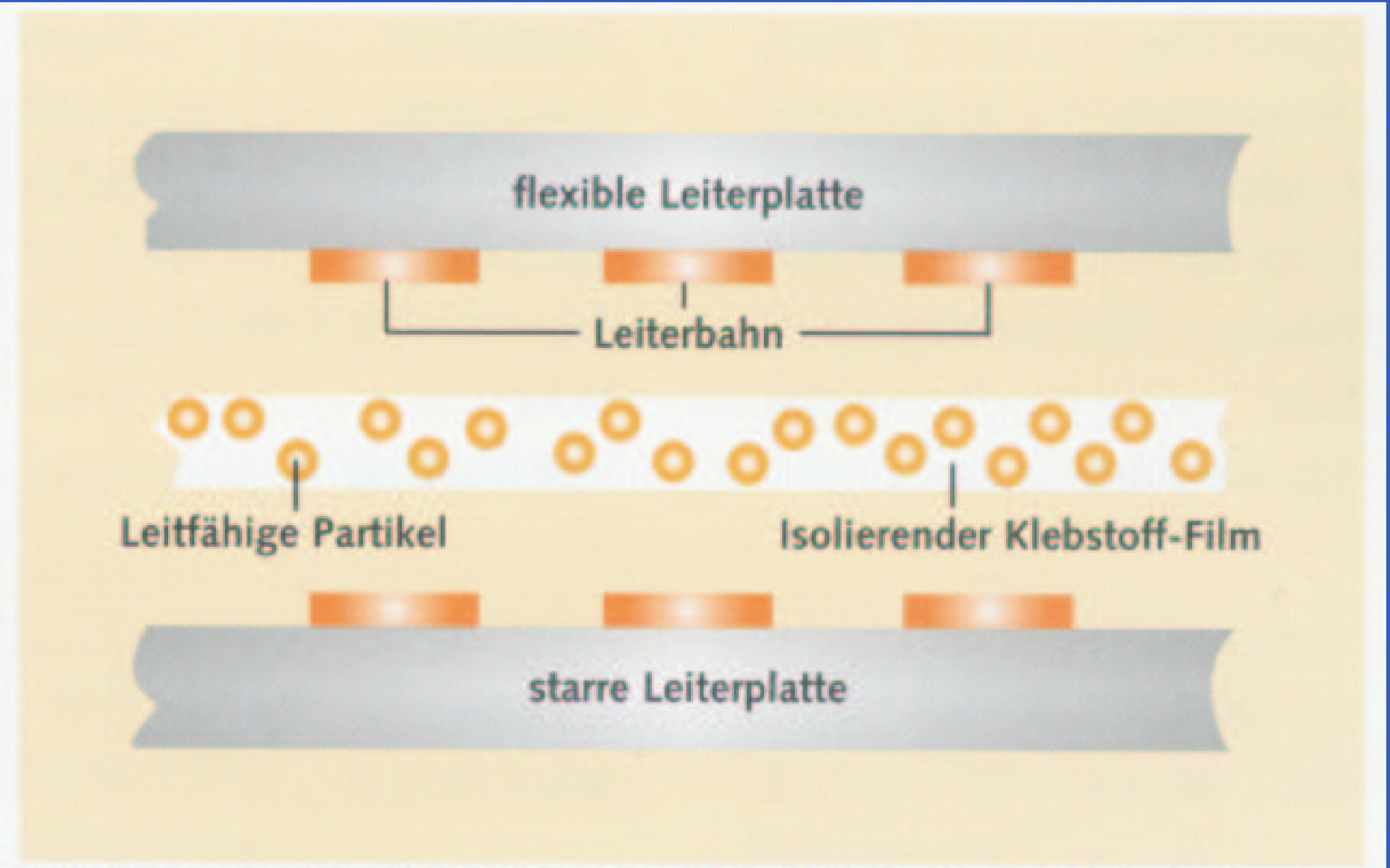
Cable bonding tests

What is ACF bonding ?

- little conductive metal spheres are added to the tape
- when curing the tape under pressure and heat, the spheres get pressed into the bonding footprints and thus provide electrical contact

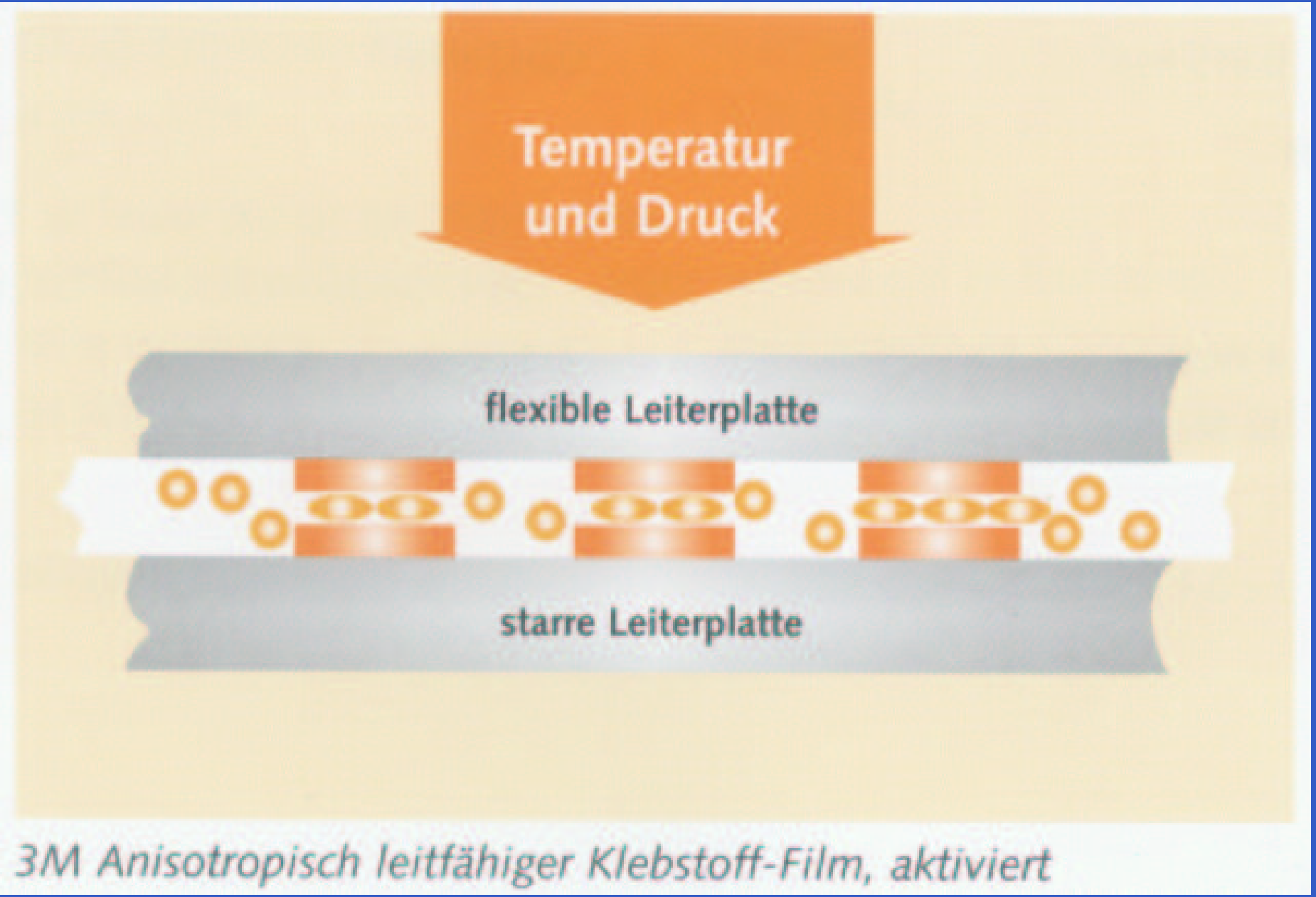


ACF before bonding



3M Anisotropisch leitfähiger Klebstoff-Film, nicht aktiviert

ACF after bonding



3M Anisotropisch leitfähiger Klebstoff-Film, aktiviert

More ACF bonding

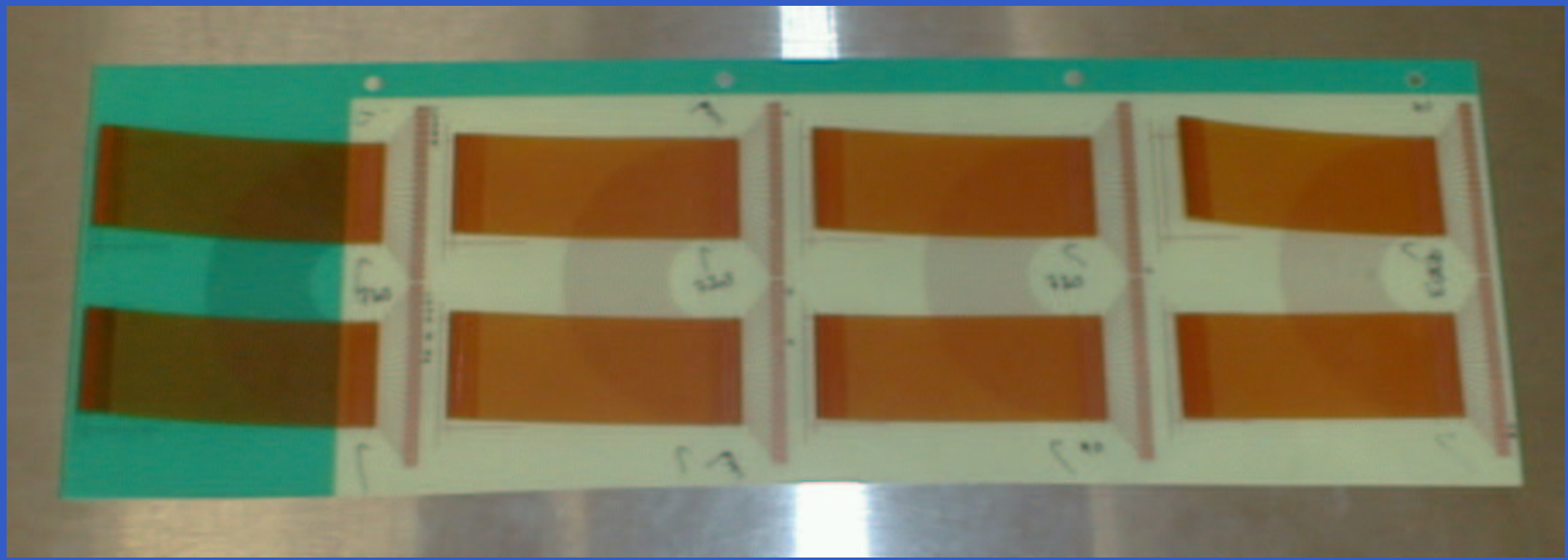
- ACF is used in these industrial sectors :
  - mobile phone manufacturing
  - automobile industry
  - LCD production / mobile computers
- requires bonding gold on both footprints for good contact
- selected ACF film for cable bonding tests : 3M 7303

Properties of 3M Z-axis adhesive film 7303

- adhesive thickness 62,5 μm
- silver coated glass spheres, diameter 35 μm
- minimum gap between pads 0.25 mm
- minimum overlap area 0.8 mm^2
- peel strength 500 g/cm $\Leftrightarrow$ 1 kg per cable
- interconnect resistance 0.5 - 0.6 Ω
- resistance stability 5.0 Ω or better
- bonding conditions :
  - temperature 135 °C
  - pressure 15-18 kg/cm^2
  - time 25 s

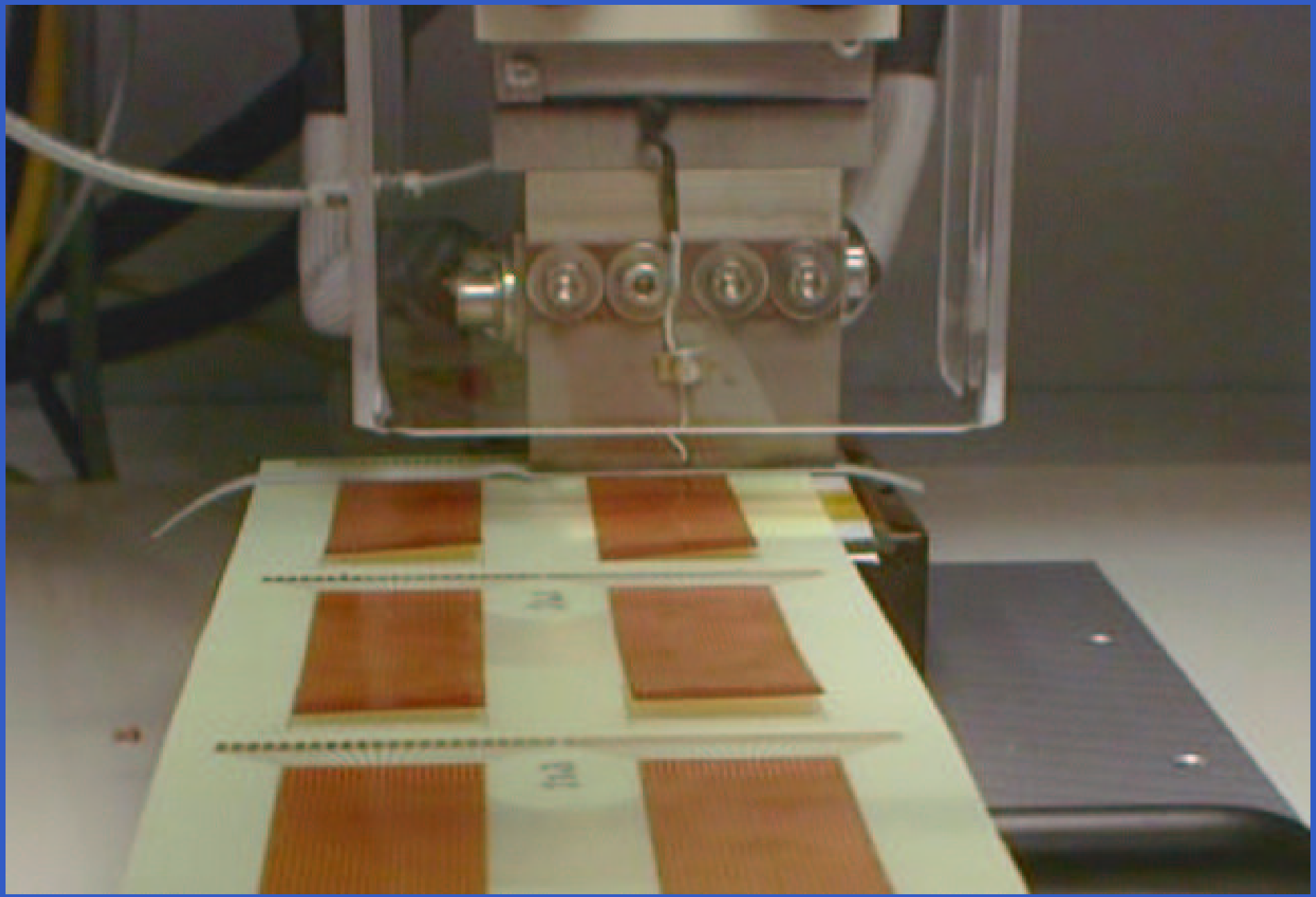
Bonding step 1 : Tape

Bonding step 2 : Align

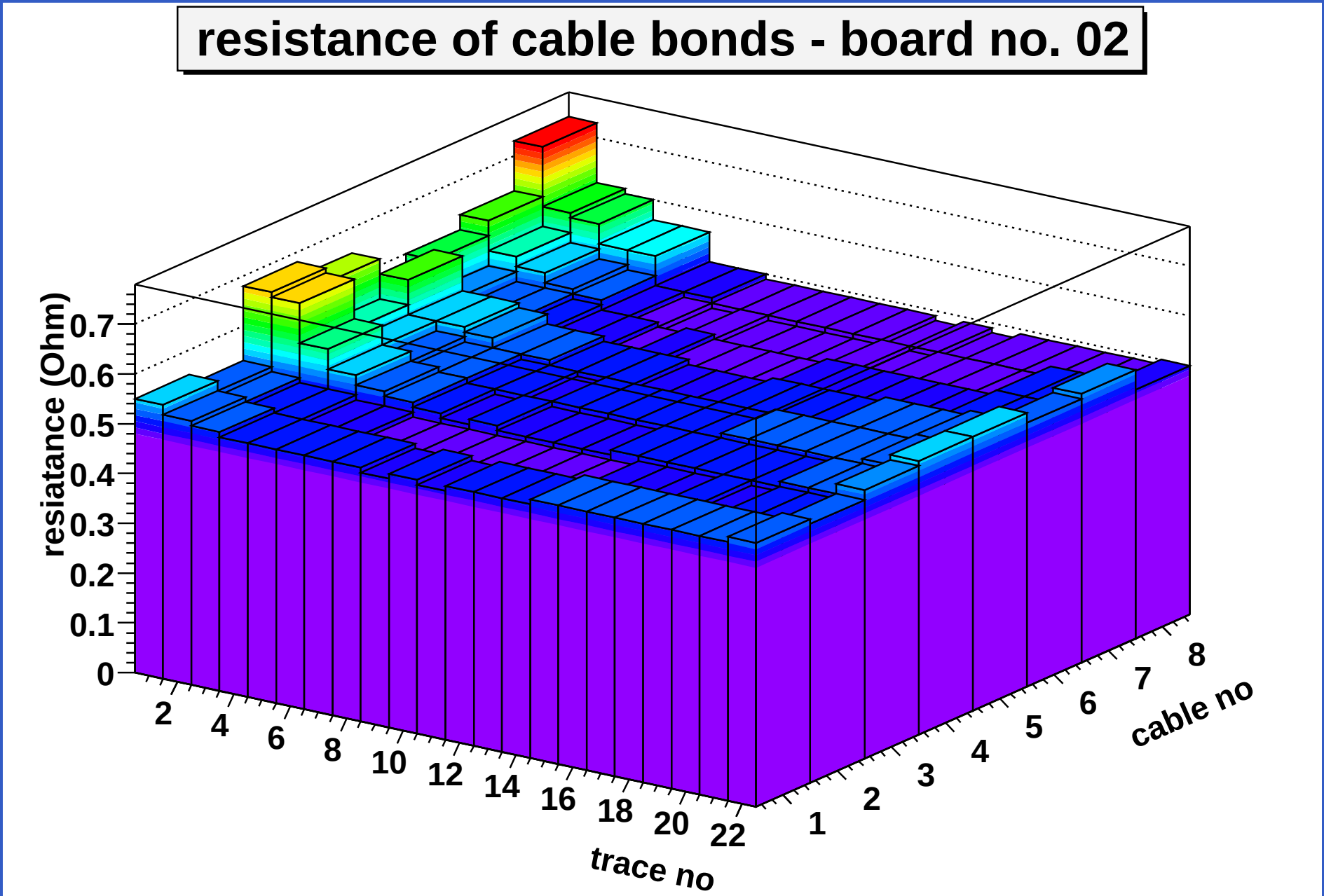


- alignment can be done by hand

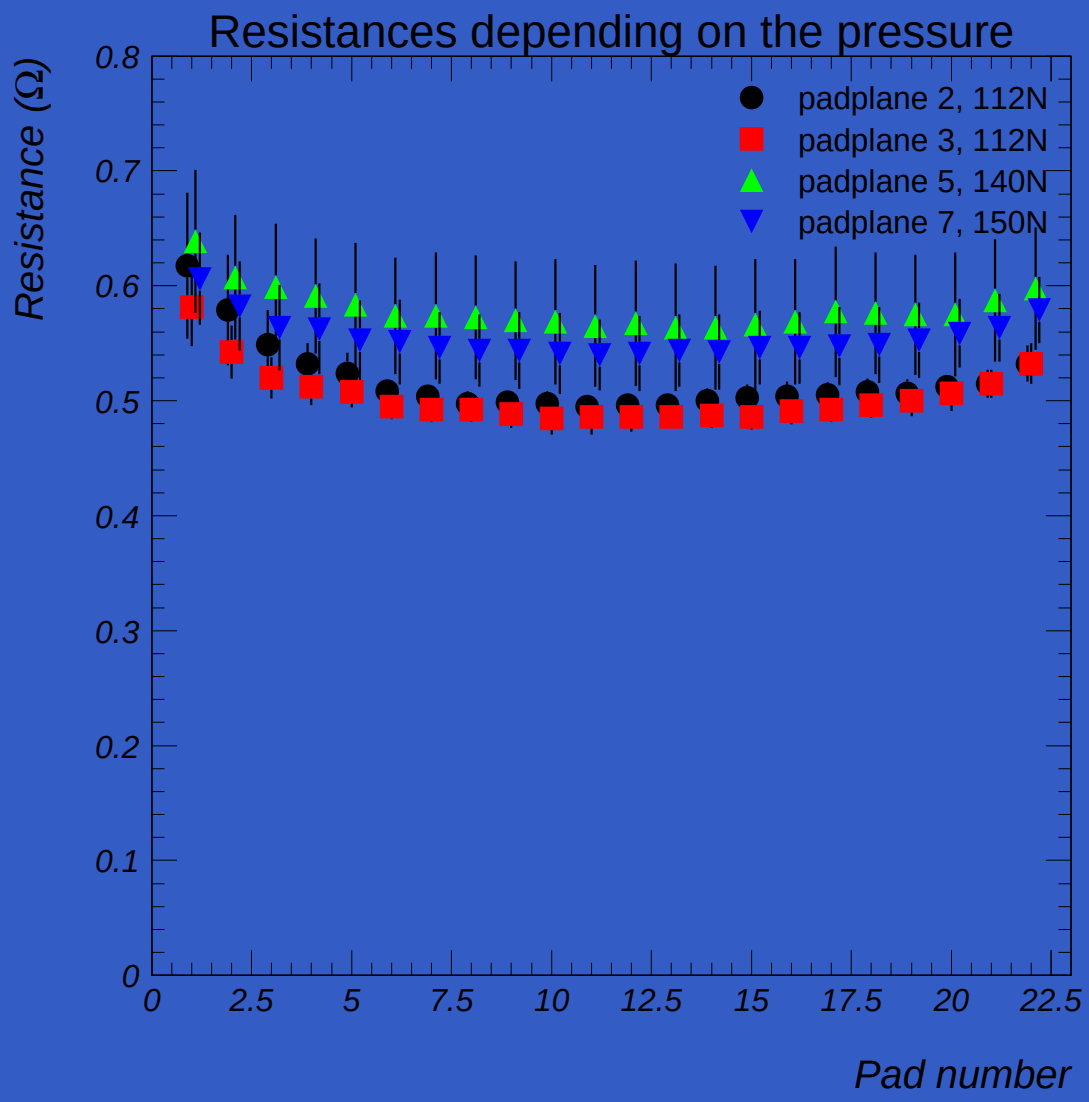
Bonding step 3 : Bond



Bonding test results



More bonding test results



Results and Conclusions

- bond resistance including cable and connector is $0.55 \pm 0.1\ \Omega$
- U-shaped Ω-distribution due to heat loss on rims
- cable bonding is a quick, reliable procedure
- pad plane does not deform under bonding heat up to 200 °C
- poorly connected cables can simply be peeled off and rebonded with another cable after cleaning the footprint

- but : our pad planes are to large to be gold plated

  $\Rightarrow$ have to solder the cables

Thank you very much
for your attention