

METROLOGY OF THE OTE CYLINDER FOR ENCAP C

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- **Introduction**

The resulting diameter of the OTE depends on some parameters, mainly:

- Airex length.
- Mandrel diameter.
- Pressure applied during gluing.

Thanks to vacuum bagging we can apply a uniform pressure over the cylinder during gluing.

The length of Airex was established based on previous prototypes and is described in the assembly document. It is also visually checked with the Airex rolled over the mandrel, before applying glue.

The mandrel was designed with a removable shim that allows us to collapse it slightly in order to easily extract the cylinder once glued. It also allows for some adjustment of the perimeter of the mandrel.

- **Setting of the mandrel diameter**

According to the results of earlier prototypes we observed that the mandrel diameter should be adjusted at about 1 mm smaller than the OTE nominal inner diameter.

Consequently we adjusted the aluminium shim of the collapsible mandrel and we obtained measurement series "Mandrel #1" and its corresponding mean (see figure 1)

Then we assembled a test band (23 cm width), which resulted well within tolerances (see figure 1). The measurement of the band diameter done at Liverpool (1197.1 mm) also confirmed our results.

We remeasured the mandrel just before the assembling the OTE (series "Mandrel #2" in figure 1).

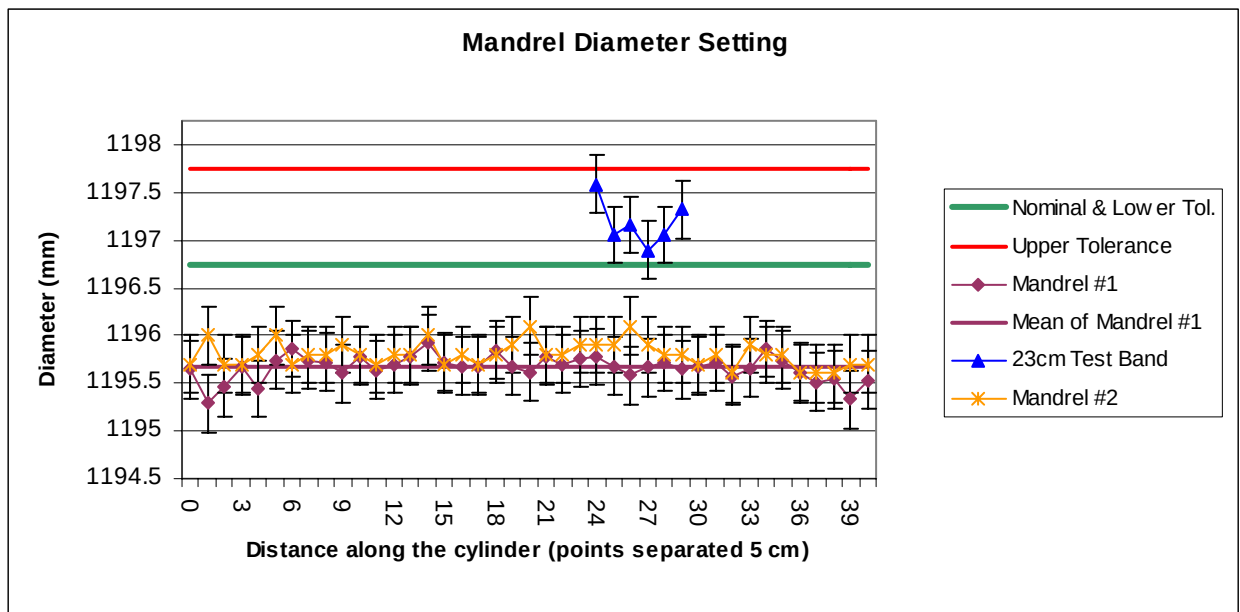


Figure 1

- **Results of OTE outer diameter**

With the previous adjustments we assembled the OTE cylinder for the Endcap C.

For measuring the outer diameter at each section we take the approach of measuring the perimeter directly.

We use a stainless steel band especially suited for this task, with laser engraved marks and a vernier scale, whose measurements are already corrected taking into account the band thickness. We had verified the good agreement between measurements made with this band and the ones made with adhesive metallic tapes.

All the measurements of the outer diameter along the cylinder length are within tolerances with exception of just the two end points. (see figure 2)

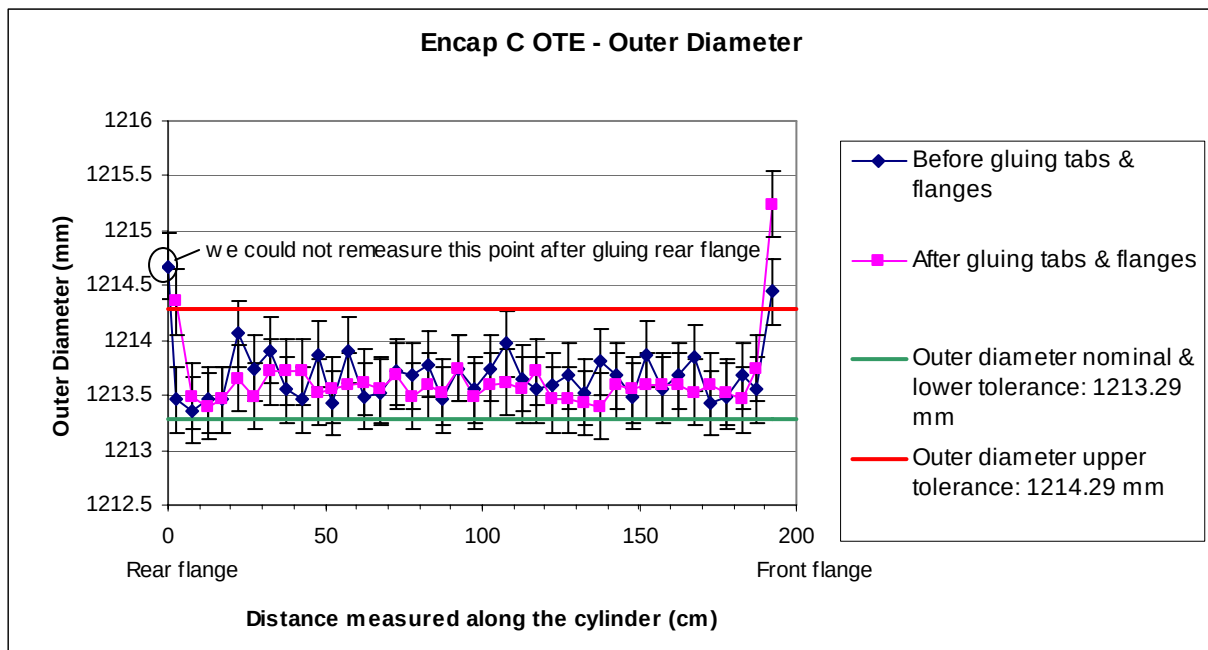


Figure 2

To join electrically the outer Cu layer to the internal Al layer, we glued 8 tabs of Cu-Kapton at each ending, evenly spaced at 45°.

In figure 2 we can see that the diameter at both endings increased after gluing these tabs and the flanges. At the front flange side, the outer diameter finally results 1 mm bigger than the upper tolerance value.

At the rear flange side, we could not remeasure the diameter just under the rear flange, but we also see an increment of the diameter in the nearest section. It must be noticed though, that in this section the tabs that come from the rear flange also overlap with the cylinder.

- **Results of OTE inner diameter**

We have calculated the inner diameter subtracting the width of the Airex sandwich from the outer diameter.

Although we measured directly the inner diameter for some band prototypes with adhesive measuring tapes, it proved to be much less accurate, besides being impractical for the real OTE due to its length. We also observed some delamination in the aluminium of the Al-Kapton film in the prototypes that we measured internally due to the adhesive of the tape.

In the areas where there is not overlap of film layers, grounding tabs or solderings, the mean measured thickness of the Cu-Kapton/glue/airex/glue/Al-Kapton sandwich was 8.05 mm. This value is somewhat lower than the theoretical value (8.27 mm), probably

due to Airex compression during vacuum gluing. Thus the inner diameter results closer to the upper tolerance limit than the outer (see figure 3).

For the measurements after gluing tabs & flanges, at the front flange side we have subtracted the width of the grounding tabs, estimated as 600 microns (4 Cu-Kapton layers of about 50 microns and 4 glue layers of about 100 microns), and at the rear flange side we have subtracted the contribution of the Cu-Kapton tabs that come from the rear flange, estimated as 400 microns (2 Cu-Kapton layers of about 50 microns and 2 glue layers of about 150 microns)

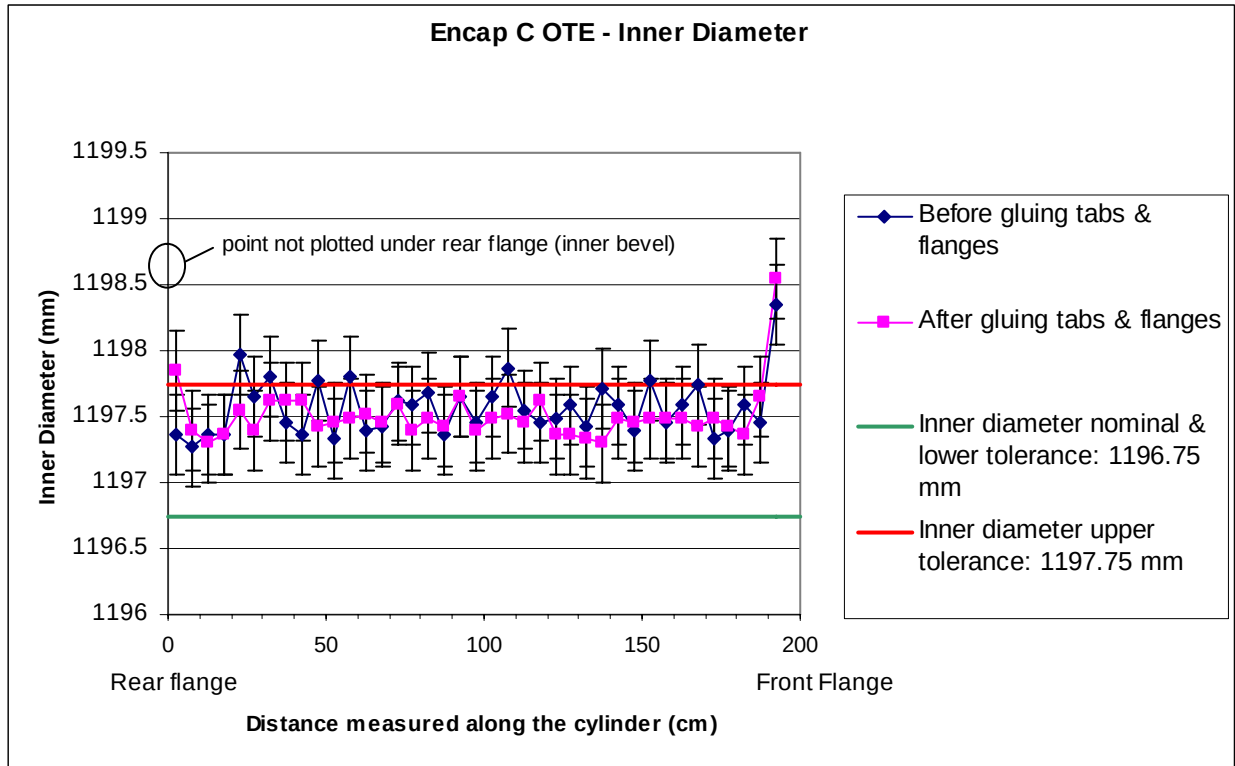


Figure 3

- **Conclusions**

We have shown the measurements of the diameter of the assembled OTE cylinder (for Encap C).

These measurements show that the outer diameter is within tolerances except for the two endings of the cylinder.

The outer diameter increased at both endings after gluing the grounding tabs and the flanges.

Finally, the inner diameter results closer to the upper tolerance line than the outer.