RICH assembly

- Aerogel panel
- Reflector
- Radiator
- USS 02
- Secondary structure
Aerogel panel

- Aerogel tile
- Sodium Fluorite
- Sealing foil
- CFRC/Al support & container
Aerogel panel

- Aerogel tile
- Sodium Fluorite
- CFRC support & container
Aerogel panel

Sodium Fluorite thickness = 5 mm

Aerogel tile thickness = 30 mm
Reflector: new philosophy

Exploded view of the three shell sections. The sections will be glued together at the vertical sides upon final fitting on the mandrel.

Top view of the mirror completely assembled.
Reflector design

- **MATERIAL**: BRYTE EX-1515 (Cyanate Ester resin system)
- **LAMINATION**: 8 LAYERS: 
  \[0^\circ/45^\circ/-45^\circ/90^\circ/90^\circ/-45^\circ/45^\circ/0^\circ\]
- **REFLECTING SURFACE**: ALUMINUM PLATED WITH MgF₂ PROTECTION
- **WEIGHT**: 3,5 Kg (CARRIER) + 1,5 Kg max (JOINTS)
- **STIFFENERS**: CARBON FIBER FLANGES ON BOTH BASE AND TOP
- **JOINTS TO SECONDARY STRUCTURE**: STEEL PLATES
- **MANDREL**: (LATHE MADE)
Mandrel measurement

**Reflector specifications**
- Diameter D1 = 1340 mm ± 0.2 mm
- Diameter D2 = 1200 mm ± 0.2 mm
- Conicity tolerance = 0.2 m
- Centring tolerance = 0.1 mm

<table>
<thead>
<tr>
<th>Z (mm)</th>
<th>DIAMETER [mm]</th>
<th>CIRCOLARITY [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>1339.616</td>
<td>0.053</td>
</tr>
<tr>
<td>518</td>
<td>1199.731</td>
<td>0.063</td>
</tr>
<tr>
<td>100</td>
<td>1324.248</td>
<td>0.03</td>
</tr>
<tr>
<td>150</td>
<td>1309.367</td>
<td>0.036</td>
</tr>
<tr>
<td>200</td>
<td>1294.459</td>
<td>0.022</td>
</tr>
<tr>
<td>250</td>
<td>1279.592</td>
<td>0.027</td>
</tr>
<tr>
<td>300</td>
<td>1264.698</td>
<td>0.029</td>
</tr>
<tr>
<td>350</td>
<td>1249.819</td>
<td>0.033</td>
</tr>
<tr>
<td>400</td>
<td>1234.934</td>
<td>0.049</td>
</tr>
<tr>
<td>450</td>
<td>1220.049</td>
<td>0.056</td>
</tr>
</tbody>
</table>

**Generatrix Linearity**

<table>
<thead>
<tr>
<th>Linearity</th>
<th>Value [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° (from x axis)</td>
<td>0.043</td>
</tr>
<tr>
<td>180° (from x axis)</td>
<td>0.068</td>
</tr>
<tr>
<td>90° (from x axis)</td>
<td>0.049</td>
</tr>
<tr>
<td>-90° (from x axis)</td>
<td>0.036</td>
</tr>
</tbody>
</table>

**Centring Deviation**

<table>
<thead>
<tr>
<th>Z (mm)</th>
<th>X [mm]</th>
<th>Y [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>-0.0046</td>
<td>0.013</td>
</tr>
</tbody>
</table>

**Cone Angle**

<table>
<thead>
<tr>
<th>Cone Angle [deg]</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.92909</td>
<td></td>
</tr>
</tbody>
</table>

**Conicity**

<table>
<thead>
<tr>
<th>Z (mm)</th>
<th>Conicity [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>0.070</td>
</tr>
</tbody>
</table>
Roughness measure

<table>
<thead>
<tr>
<th></th>
<th>measure orientation: 0° from cone axis</th>
<th>measure orientation: 45° from cone axis</th>
<th>measure orientation: 90° from cone axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS Roughness [nm] (average on 90 points)</td>
<td>2.3</td>
<td>8.0</td>
<td>4.4</td>
</tr>
</tbody>
</table>

![Graph showing RMS roughness measurements at different orientations.](image)
Carlo Gavazzi Space SpA

RICH

Mandrel manufacturing conclusion

March 31 - April 5, 2003

CERN, Geneva

AMS-02 TIM
Vibration test
(Philosophy & Run sequence)

Maximum Expected Flight Levels = 3.2g RMS
Minimum Workmanship Levels = 6.8g RMS

1. Test on single-PMT assembly A: starting from MEFL up to breakage (90 s @ MEFL + 90 s @ MWL +30 @+3dB till breakage)
2. Test on single-PMT assembly B: starting from MEFL up to breakage (90 s @ MEFL + 90 s @ MWL +30 @+3dB till breakage)

PURPOSE: find out the mechanical limits

3. Test on 8-PMTs assembly at MWL (90 seconds on each axis)

PURPOSE: qualify the mechanical assembly
Vibration test
(single PMT (A) test)

Breakage @ 29 g RMS
(total time under vibration >10 minutes)
Vibration test
(single PMT (B) test)

Breakage @ 19.1 g RMS
(total time under vibration >8 minutes)
Vibration test
(flex test)

accelerometer
Vibration test (flex test)

Non-tensioned Kevlar wire
Vibration test
(Conclusions)

1. **Test on single-PMT assemblies**: breakage occurred at 19.1 and at 27 g RMS (3 to 4 times the qualification level).

2. Breakage location: Kevlar wire; breakage caused by wear => total time under load= 8 to 10 minutes. A possible improvement may be done in the LG cut

1. **Test on 8-PMTs assembly**: full mechanical qualification: vibration on 3 axis @ MWL for 90 seconds; no breakage occurred even in the LG with only one wire working.

2. The flex fixation and the flex itself didn’t show any mechanical damage. All the PMTs tested at Grenoble (functionality test) after vibration, work correctly.
PMT assembly

- Light guide
- Kevlar wire
- Housing
- Shielding
- Electronics
- Kapton flex
- Connector