According to the 727s156a and 727s201b reports we have analyzed all the possible solutions to the problems we have currently on the mirror covers. In the following pages we suggest some modifications to be applied on the device in order to remove interferences and deflections of the structures.

First of all I would like to point out some general comments I have on your ‘Status of LBT Mirror Cover’.

1. The LBT / Colombo contract concerned all the mechanical supplying as depicted in 727a007b General Assembly: the carpentry structure, the commercial mechanisms and the assembly of the cover. The electrical motors and devices, as well as the proximities and stow-pins, were in the contract for ‘supplying only’; the electrical cabinet necessary for the tests (for moving motors and locking pins) was not in the contract as well as the servo amplifiers for the motors. All these components were just ‘temporary for testing’ and were not included in the contract.

2. However, the general philosophy of the supplying, when delivered by Colombo, was not a ‘turnkey subsystem - ready to go’ because the LBT-PO knew in advance that many aspects were not included the contract: all the electrical connections and the harness on board, the electrical cabinet and the servo amplifiers for the AC and DC motors, and any logical interfacing with the TCS. Last but not least, the mirror covers have not been tested horizon pointing because the workshop area was not high as needed.

3. Most of the problems we have now on the telescope come from the interfacing with the telescope structure (M1 Cell and M3 spider) and the first test performed on the real elevation structure, moving from horizon to zenith and vice versa, has been the only test possible to evaluate the static and dynamic behaviour of the mirror cover structure connected to the front windbracing.

4. Other problems related to the shipping of the structures, as corrosion all over the components due to a significant amount of water inside the seal bags, have been partially recovered by the 14,000.00 $ detracted from the final payment to Colombo.
I hope that the above notes reminder to everybody which has been the LBT Project Office approach along the way from the preliminary conceptual design to the final delivery of the mirror covers from Italy.

**Technical Problems and Suggested Solutions.**

We refer to the ‘Summary’ on 727s156a page 5 in order to analyze the problems and then suggest possible solutions. This is the summary table:

<table>
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<tr>
<th>Issue</th>
<th>Reference</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>5.2 and [RD3]</td>
<td>Lack of stiffness in Z, low resonant frequency</td>
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<tr>
<td>2</td>
<td>5.3 and [RD3]</td>
<td>Lack of stiffness in Y with swing arm retracted, low resonant frequency</td>
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<tr>
<td>3</td>
<td>5.4 and [RD3]</td>
<td>Blade support mechanism failure</td>
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<tr>
<td>4</td>
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<td>Swing arm stow pin mechanism reliability and alignment</td>
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<tr>
<td>5</td>
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<td>6.5</td>
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</tbody>
</table>

According to the above summary we agree to split the issues summarized in the list in three different subjects:

a. Interference with telescope structures
b. Mechanisms failure
c. Lack of stiffness (low resonant frequency)

Each of the items relates to different kind of problems and we suggest to solve one problem at the time because some of them requires minor arrangements and activities on the telescope, some others require new tests and surveying on the telescope. We think that a step-by-step strategy in solving problem is more performing that a different approach.
a. Interference with telescope structures

**Analysis:**

- Some of the problems come from some washers added during the tests in Italy under the parking rail where the rollers stack when the mirror cover is undeployed. These washers moved away in Z the rail, and the rollers, from their nominal position and consequently the structure requested an additional shim under the main post. Moreover we need to remove few tens of millimetres from a radial steel support to avoid interference with the M1 mirror cell edge (see picture 1).

![Picture 1](image)

**Proposal:**

- remove the washers on the rollers around the parking rail and adjust the radial steel bar (see Fig. 1);
- grinding some millimetres off on the lower side of the central hub (currently too close to the mirror cell edge when engaging/disengaging) (see Fig.2)
- check the new clearance by new surveying before the next assembling test.
b. **Mechanisms failure**

**Analysis:**

It is our opinion that most of the misalignments occurring with the blades, the rollers and the stow pins are due to some combined deflections of the mirror cover structure and the front windbracing where the main post is connected. We suppose that some of the failures of the mechanisms are due to possible incorrect local set-up and/or insufficient clearance between the components, in addition to some others problems related to the lack of stiffness of the structures.

In order to better understand the different contributions of the misalignment between the components and the structural lack of stiffness it is necessary to have more detailed measurements of the front windbracing and the mirror cover local deflections versus the elevation angle of the telescope. This is necessary in order to better understand the lack of stiffness of the main post and the T-beam of the mirror cover compared with the front windbracing, in both planes X-Y and Y-Z: this is a preliminary analysis for making some proposals to increase the stiffness of these structures.

**Proposal:**

- as soon as we have removed all the current interferences between the mirror cover and the M1 mirror cell we can test again the mirror cover deploying movement having a detailed map of the local deflection every 5º, between 0º and 90 º of the deploying movement.
The goal is to improve the stiffness of the main post, and of the T-beam of the mirror cover, to reduce the deflections within an acceptable value.

c. Lack of stiffness (low resonant frequency)

Analysis:

As fully demonstrated in the report 727s201b ‘Flexural Test Results’ the lowest eigenfrequency of the mirror cover structure is around 3.3 Hz oriented along the Z axis. This low eigenfrequency was expected, of course, at the designing and manufacturing time but any solution had been postponed after the test on the telescope because many correlated problems needed to be investigated.

Our current problem solving strategy is related to find out the proper location for a new dumping device connecting the mirror cover T-beam end to the front windbracing structure, as supposed when we designed the structure.

In the meantime we suggest to think about a new location also for the stow-pin currently installed on the main post of the mirror cover. This stow-pin is necessary to match the exact positions when the mirror cover is undeployed as well as it is deployed, but, right now, it is affected by the deformation of the structures.

Proposal:

- the design of a relative small support where it will possible locate the dumping system, and/or move the stow-pin, needs an accurate analysis on site with the mirror cover installed on the telescope. For this reason we suggest to find a solution to this problem as soon as we have solved the problem discussed in paragraph a. and b. above. We are convinced that only with the mirror cover installed and fully working, without any interference or lack of stiffness somewhere, it will be possible to have some additional measurement and to design a small structure, probably connected and supported by the front windbracing, to constrain the mirror cover in X, Y and Z direction improving its lower eigenfrequencies.
The three steps described above require a detailed scheduling for modifications on the ground and new tests on the telescope; these activities need to be supported by a couple of people on site plus a technical supervisor to carry out the modifications first and then to perform new tests on the telescope. Probably it means to have two or three weeks available for these activities in the next two/three months.