VST Project

Software Procedures

Primary Mirror Integration in the Cell

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Index

Reference Documents

id.	Document code	Title	Source	Date	Issue
RD1	VST-PRO-OAC-22000-1111	M1 Handling Device and integration of primary mirror in the cell	VST	30/05/2006	1.0
RD2	VST-MAN-OAC-22000-1231	M1 Handling Device Operation Manual	VST	30/05/2006	1.0

1 Introduction

This document contains procedure information on Primary Mirror (M1) extraction and integration from and in the mirror cell, from the software (SW) point of view. Therefore this document should be considered an integration to the whole procedures, described in [RD1], together with SW instruction about M1 Handling Device (HD) operation and fine tuning, described in [RD2].

2 Scope of the document

Scope of the document is basically to show SW details about M1 HD operation and integration/extraction of M1 in/out of the cell. In particular the section dedicated to the insertion of M1 in the cell should be considered as a draft description of current procedure used and a proposal of a more safe procedure. The final correct procedure must be of course subject of a further technical discussion followed by a series of tests on real system.

This document doesn't intentionally report aspects of procedures related to specific Paranal environment conditions. Basic purpose is, in fact, to describe only the M1 handling operations in the integration facility in Italy.

3 M1 Handling Device Setup Tools

In order to handle the VST M1, a specific HD is provided. From the mechanical point of view, the HD components and assembly procedures are described in [RD2].

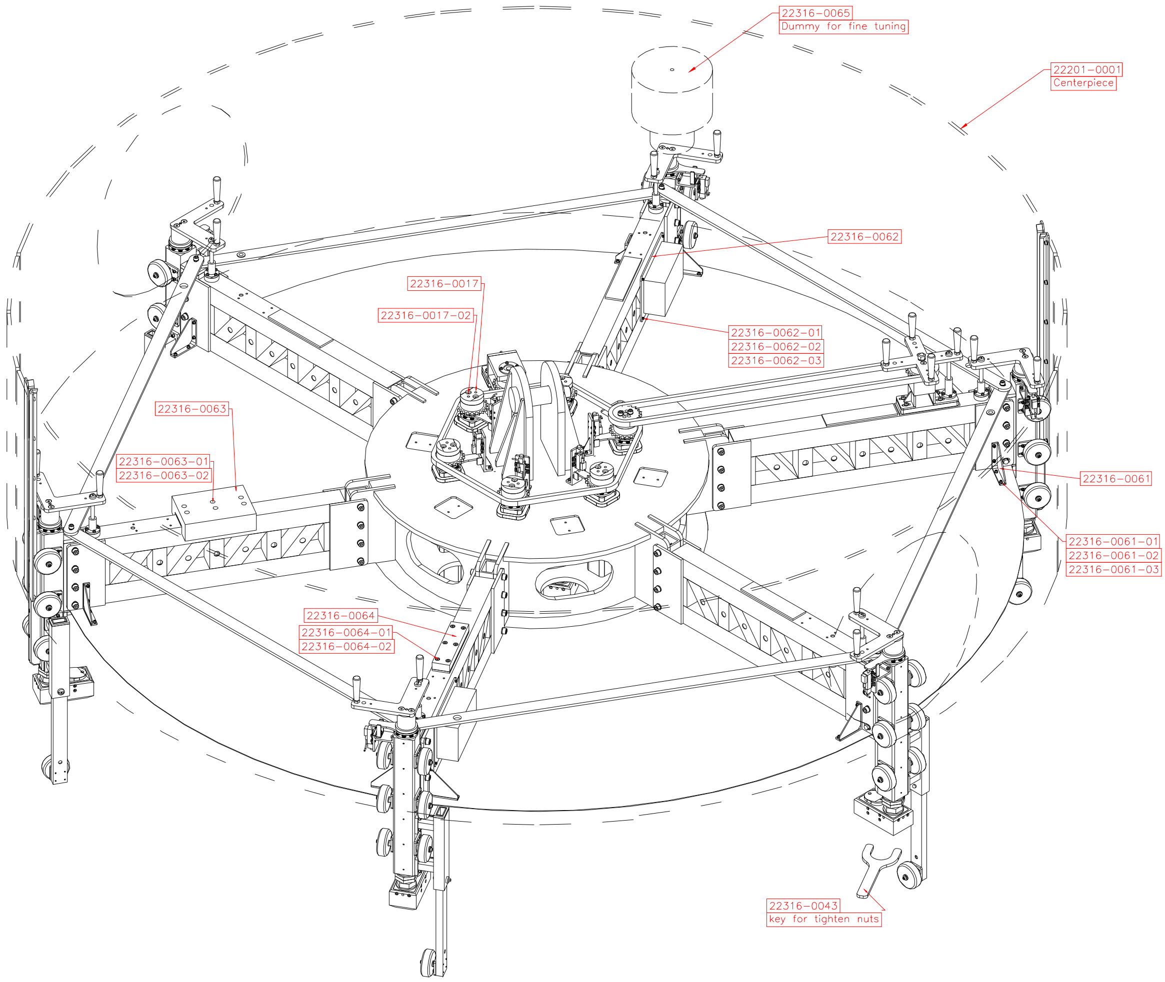

Fig. 3-1 – the M1 Handling Device 3D view

In particular, in the chapter 4 of [RD2] a mechanical description of HD fine tuning procedure is described. The only information not included there is the SW facility specifically implemented for the HD tuning procedure. In the following these details are reported.

From the electronic point of view, each HD pad support is provided with a weight load measurement system composed by an LVDT device. All these devices are connected to a General Purpose (GP) board, designed and realized by VST team to perform pressure, weight and temperature measurements in many subsystems of the telescope. Through a dedicated CAN bus, the values read from HD pad LVDTs are delivered to the M1/M2 control LCU (ltvm12) and from there to the Telescope Control System (TCS) WorkStation (WS), where specific engineering user interface panels can be used to monitor the current status of M1 weight load distribution on the HD pad supports (that are the parts directly interfacing with mirror surface.
The M1 HD engineering user interface panel, *vstm1asHD*, is shown in Fig. 3-2.

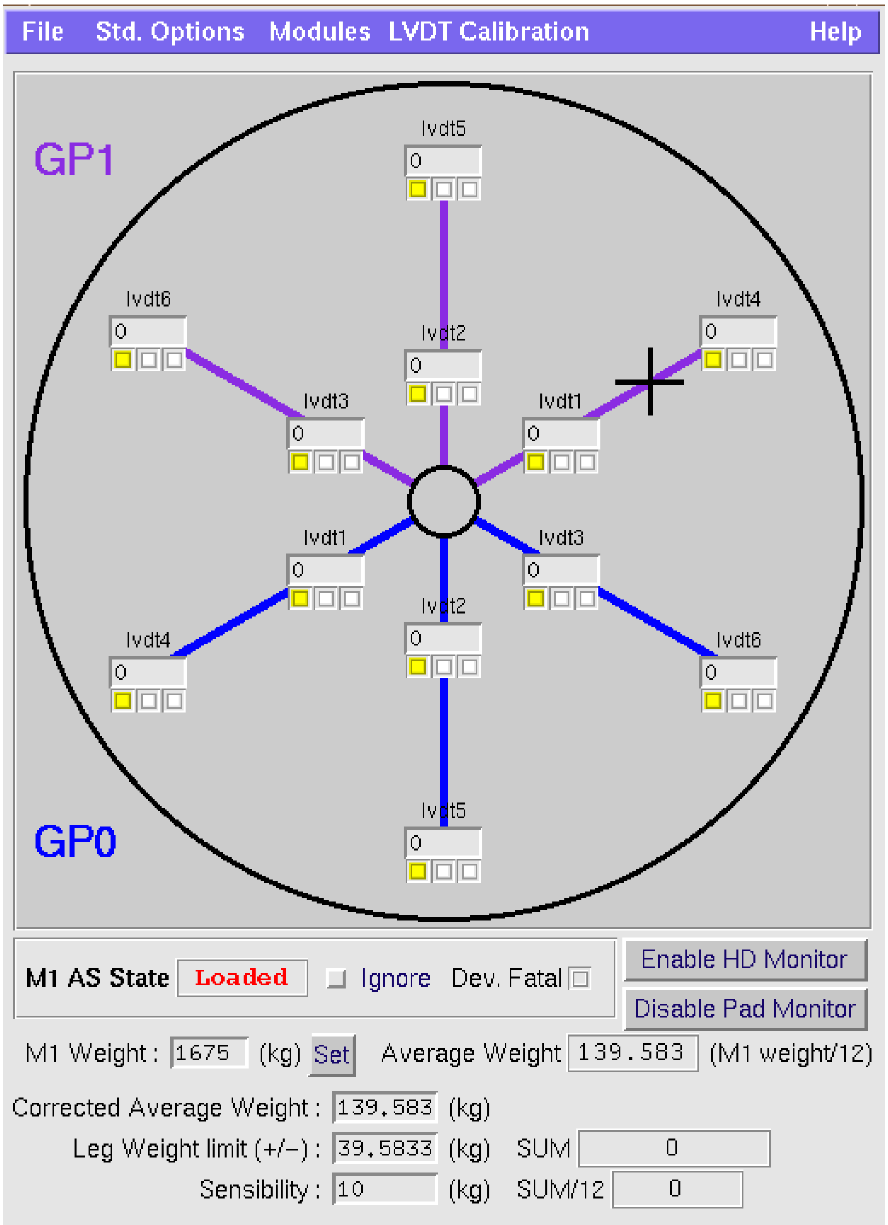

Fig. 3-2 – the M1 Handling Device engineering user interface

Through this panel it is possible to verify and tune the load distribution on both external and internal HD pad supports. Using weight load readout on pad supports as feedback, it is possible to follow the HD fine tuning procedure reported in the chapter 4 of [RD2]. In particular, a correct load distribution on the supports is obtained when in the panel all the LVDT objects are green (Fig. 3-3). As reported in [RD2], each HD pad axis has a correct weight load if the value is in a range of 50 Kg ± 10%.

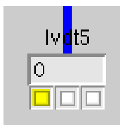

Fig. 3-3 – detail of LVDT load status object in the panel

At the end of the HD fine tuning procedure, it will be possible to use the HD with the mirror in a safe condition.

4 M1 Insertion/Extraction Software Tools

The detailed procedures to grasp and to move M1 in/out of the cell are described in [RD1]. From the SW point of view, it is foreseen a WS engineering user interface, *vstm1asM1INS*, giving the capability to read axial actuator load currently applied (by means of load cells) and to set forces to be applied in parallel to all axial actuators. The internal communication between LCU and actuator devices is based on a dedicated CAN bus. The WS panel is shown in Fig. 4-1.

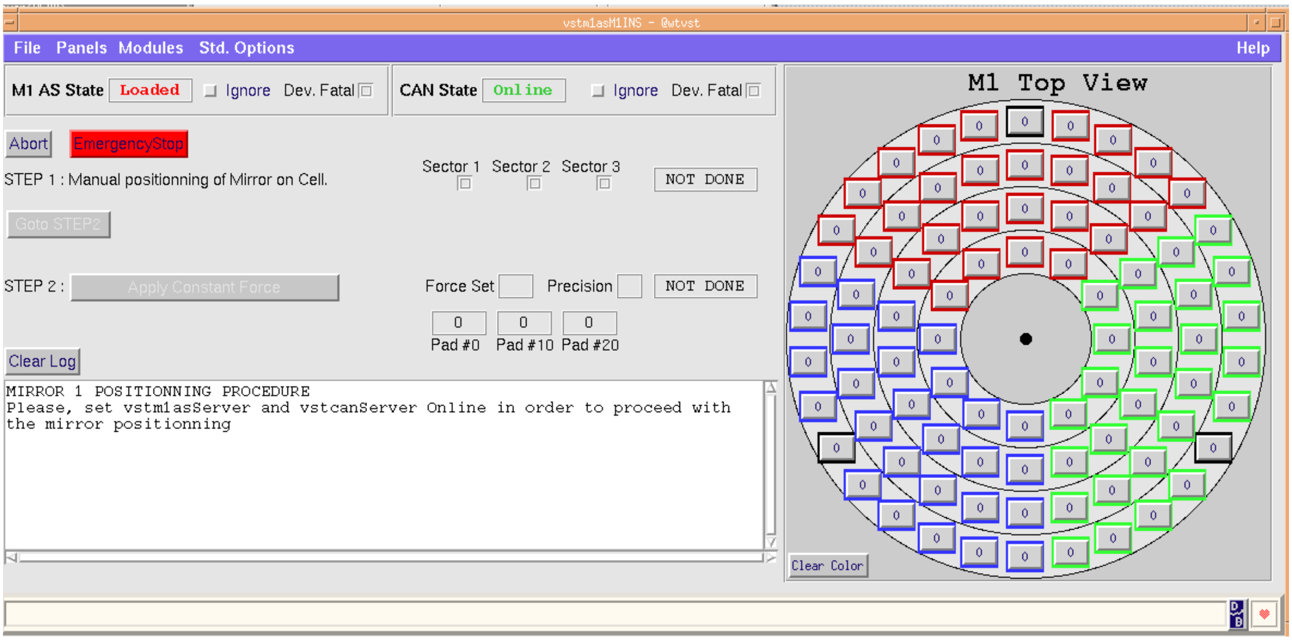

Fig. 4-1 – the WS engineering user interface for M1 actuator force distribution control

From a conceptual point of view, the extraction of M1 from the cell doesn't show any particular problem or difficulty. It is sufficient to follow the grasping and extraction mechanical procedures reported in [RD1]. Concerning the M1 insertion procedure, the main careful operation is of course the final positioning of M1 in contact with the actuators. This is in fact the most critical step, because there is the possibility to damage actuators or their load cells if M1 is not correctly positioned (i.e. local unbalanced distribution of forces on some actuators).

So far, in order to prevent this event, a very careful sequence of actions must be designed on the final step of the M1 insertion procedure. Referring to the last insertion of M1 dummy in the cell at the integration site, done with no mechanical damages occurred, the following procedure has been carried out.

4.1 Last M1 insertion procedure

This section reports details on SW operations performed during last insertion of the M1 dummy in the cell. The following items are related on the final step (positioning of M1 in contact with actuators) of the whole procedure, described in [RD1].

After M1 grasping and insertion in the cell, by means of a manual tackle (see Fig. 5 of step 3 in chapter 2 of [RD1]), the SW actions start to be needed during the step 3 of procedure reported in chapter 3 of [RD1], referred to the soft laying of the mirror on the axial actuator spheres.
The panel of Fig. 4-1 should be used to control this careful step of the procedure. This engineering user interface is mainly composed by two parts:

- the left side contains:
  - CAN bus and M1 control processes status report
  - abort button to allow the operator to restart the entire procedure of mirror positioning
  - first procedure step (STEP 1) area, composed by three leds showing information about the ongoing manual positioning of the mirror on actuators, and a text area reporting info about the correct/incorrect completion of this step
  - a button "goto STEP2" that it will enabled only if step 1 will be successfully completed
  - second procedure step area, composed by two text boxes where user can set force values and precisions to be applied to actuators (Fig. 4-2); the current force readout of three fixed actuators; a button "Apply constant force" to send force command to actuators; a text box reporting the status of the current procedure step;
- the right side contains:
  - a graphical representation of mirror actuator rings, grouped in three main sectors, able to report current force values and status of all actuators (each actuator box will change colours depending if any load is applied, yellow if the mirror is in contact and green when the force value read corresponds to the force value command issued).

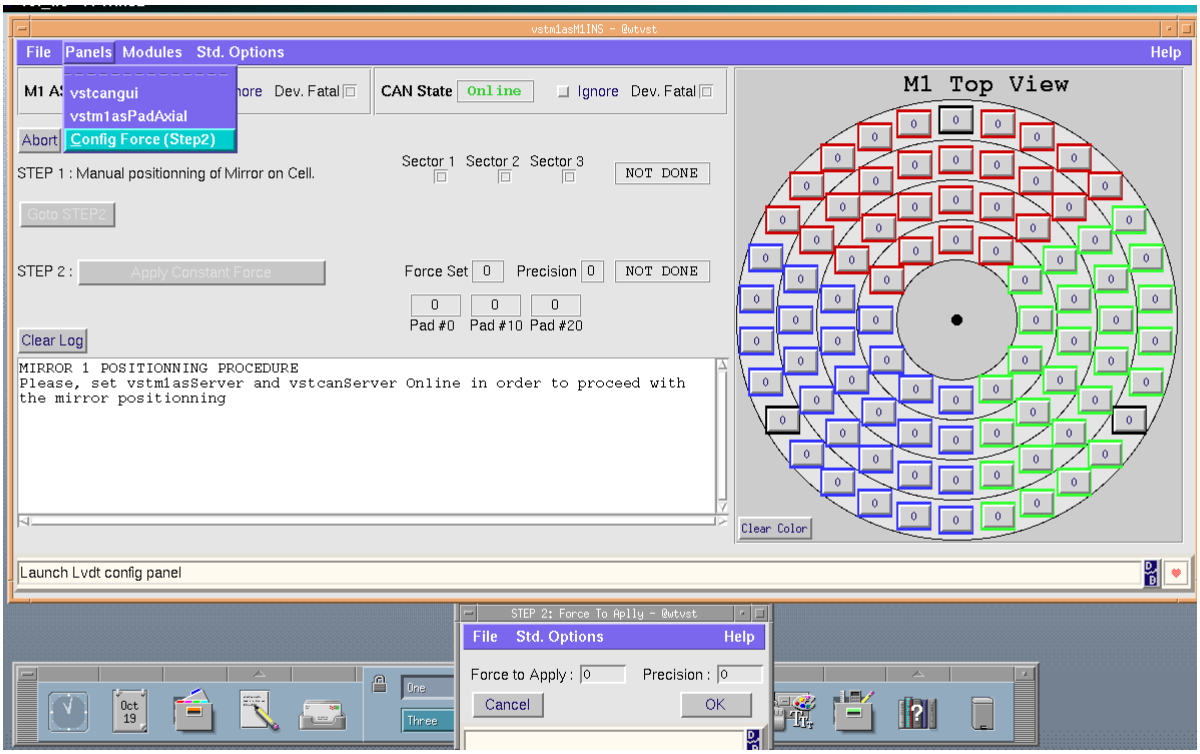

Fig. 4-2 – the popup panel to apply forces during STEP 2 of the procedure

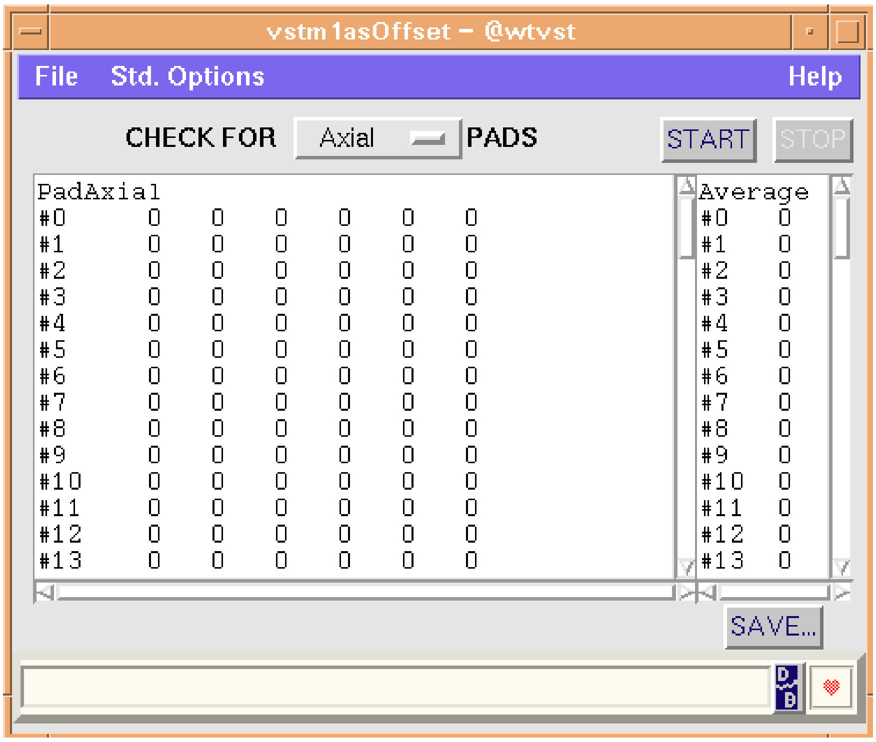

Fig. 4-3 – the panel to apply force offsets to actuators

The detailed procedure, using the SW tool, is the following:

1. before starting the procedure, be sure that
    a. the desired offsets for actuators have been set (Fig. 4-3)
    b. both processes *vstm1asServer* and *vstcanServer* are ONLINE
2. Move carefully M1 with manual tackle down to the cell having a continuous feedback from the actuator force distribution readout (panel in Fig. 4-1). When an actuator is touched by the mirror and the force value is up to 20N, the led related to that actuator sector will become yellow. On the right side of the panel the corresponding actuator box will become yellow and it will report the force value currently read by the load cell. Furthermore, on the log widget of the panel it will displayed the information about the status of all actuators really touched (Example: *Pads in contact: Sector1:10 Sector2:12 Sector3:8 (28 pads/sector)*).
3. once all actuators of a sector are touched, the corresponding led will become green.
4. When all three sector leds are green, the procedure STEP 1 is considered completed and the button “GotoSTEP2” will be enabled.
5. After selection of the button “GotoSTEP2”, a popup entry box will appear, with the possibility to fill force and precision parameters to be sent as a force command to all actuators.
6. After closing this popup window, the button “Apply constant force” will be enabled and it will be possible to send the force command to all actuators in parallel.
7. When the requested force will be applied to all actuators, all boxes on the right side of the panel will become green and the procedure can be considered as successfully completed.

4.2 Conclusions and Remarks

It is clear that the main dangerous part of the previous procedure is step 2, where in principle the mirror, grasped by the HD, must be very carefully manually laid on the actuator spheres, paying attention to the readout of load distribution over all actuators, in order to prevent any possible damage to actuators and their load cells.
In order to improve the reliability and the safety of such an operation, there is actually the possibility to use three additional LVDTs, vertically mounted in the cell and equally positioned at a distance of 120° between themselves, able to provide a precise feedback in terms of vertical position of the mirror inside the cell. Actually, these devices are physically available and provided by SW implementation as well, but not yet electronically connected to the CAN bus circuit, by means of an interconnection GP board.
So far, in my opinion, when these additional LVDTs will be in a fully operative condition, it will be possible to think about their use in the M1 insertion procedure, as follows:

1. So far, before to start step 2 of previous procedure, a possible solution could be to preset positions of all actuators down to lower limit switch. This in order to prevent that mirror can touch any actuator before to touch LVDTs.
2. Lay down carefully the mirror, touching LVDTs and three fixed actuators and read corresponding positions reached (be sure also that all three LVDTs read same position, i.e. the position mirror is well balanced in the cell) and force loads. This step should be repeated until the load on the fixed actuators is of about 300N and then set the zero point of LVDT position.
3. Set and apply an equal force command for all actuators of about 250N, and all the actuators will touch the mirror in a safe condition that can also be checked by reading their load status in the right side of the panel in Fig. 4-1.

The procedure described above is only one of possible solutions, that can be improved, tuned and that must be better investigated in all their aspects.

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