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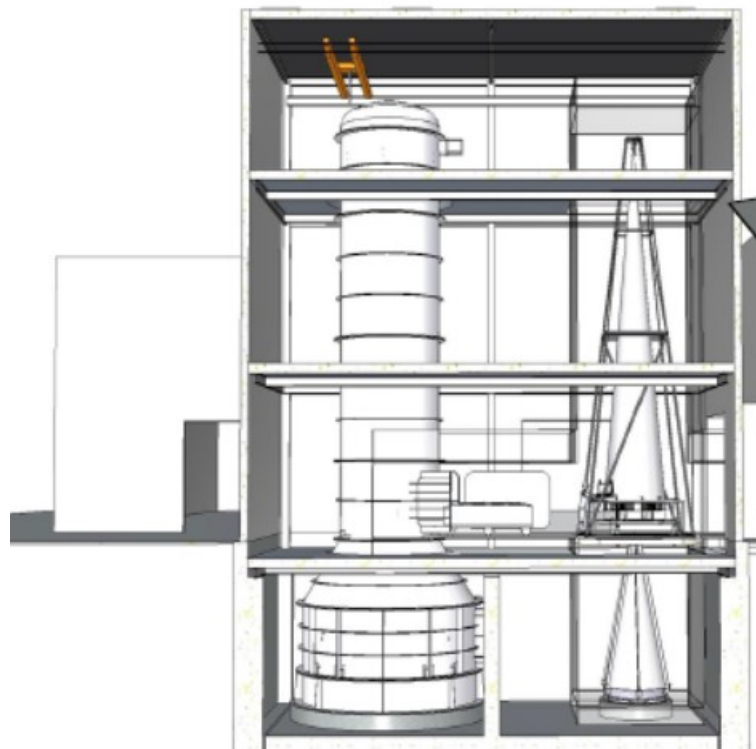


VERT-X Design of Vertical X-Ray Test Facility for ATHENA

TN21 XRS FACILITY USER MANUAL

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VERT-X Design of Vertical X-Ray Test Facility for ATHENA



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1. INTRODUCTION

1.1. SCOPE

The scope of the present document is the illustration of the instructions for the use of the VERT-X facility, following the outcomes of the Detailed Design Review (DDR) and the study activities up to the Final Review (FR).

1.2. APPLICABILITY

The present document is one of the deliverables related to the FR milestone. It is intended to be the user manual for the X-ray Raster Scanner (XRS) facility.

1.3. ROADMAP

Document section	Content description
Section 2 (Applicable and reference documents)	List of applicable documents and reference documents.
Section Error! Reference source not found. (XRS facility use instructions)	Presentation of the instructions for the use of the XRS facility.

Table 1-1: Roadmap of the document

VERT-X Design of Vertical X-Ray Test Facility for ATHENA



2. APPLICABLE AND REFERENCE DOCUMENTS

2.1. APPLICABLE DOCUMENTS

AD1	AO/1-9549/18/NL/AR - SOW	X-ray Raster Scan Facility for the ATHENA Mirror Assembly SOW
AD2	VERT-INAFOAB-001	VERTICAL X-Ray (VERT-X) Technical Proposal
AD3	ESA-TECMMO-RS-014713	Updated Requirements for the ATHENA VERT-X following the System Requirements Review

2.2. REFERENCE DOCUMENTS

RD1	VTX-OAB-ISE-REP-003	D5 Detailed Design Document
RD2		

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2.3. GENERAL SPECIFICATIONS AND STANDARD DOCUMENTS

SD1	ECSS-M-40A	Configuration management
SD2	ECSS-M-50A	Information/documentation management

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2.4. LIST OF ACRONYMS

AD	Applicable Document
AIT	Assembly, Integration and Testing
DDR	Detailed Design Review
DRW	Drawing
EIE	European Industrial Engineering
ESA	European Space Agency
FM	Flight Model
FR	Final Review
GPAP	GP Advanced Projects
I/F	Interface
IASF	Istituto di AstroFisica Spaziale (INAF, Milano)
INAF	Istituto Nazionale di AstroFisica
ITT	Invitation To Tender
MA	Mirror Assembly
ML	Media Lario S.r.l.
MM	Mirror Module
OAB	Osservatorio Astronomico di Brera (INAF, Milano)
PDR	Preliminary Design Review
QM	Qualification Model
RD	Reference Document
RS	Raster Scanner
SD	Standard Document
SOW	Statement of Work
SRR	System Requirements Review
TBA	To Be Assessed
TBC	To Be Controlled
TBD	To Be Defined
TEC	Technical Note
TVC	Thermal Vacuum Chamber
VERT-X	VERTICAL X-Ray
VTX	VERT-X
XRS	X-ray Raster Scanner
XSA	X-ray Source Assembly
XYZS	(x, y, z) stage

PART A – VERT-X CONTROL SYSTEM

3. VERT-X CONTROL SYSTEM

This section includes a description of the hardware equipment included into the VERT-X Control System, including the description of the physical connections between the hardware and the location inside the building.

The list of manuals of specific hardware is included in this section.

Such manuals are added as Annexes to the VERT-X User Manual.

4. VERT-X STATUS CONTROL

This section includes:

- The list of monitored environmental parameters (air temperature outside the vessel)
- The list of monitored functioning parameters (motor current absorptions, etc.)
- The list of monitored status parameters (vacuum, temperature, interlocks, etc.)
- The description of how the above mentioned information are located on the control panel of VERT-X

The section instructs the User on how to change VERT-X status (Calibration, Test, Measure, Maintenance)

5. TEST SESSION MANAGEMENT

This section instructs the User on how to perform testing over the main sub-systems of VERT-X from the VERT-X Control System.

6. MEASUREMENT SESSION MANAGEMENT

This section instructs the User on how to set the parameters for a measurement session to be performed over the MAM.

Verification and calibration campaigns consist of sequence and cycles of the following measure:

- Focal length
- Optical axis
- Flat field
- PSF and EA on axis
- PSF and EA off axis
- Stray light

All these tests listed are performed by the sequence of activities and commands.

6.1. MIRROR ASSEMBLY POSITIONING

This sections instructs the User on how to move the Mirror Assembly from the SPO-AIT facility to VERT-X.

Interlocks are described.

Safety procedures are described.

6.2. THERMAL VACUUM CHAMBER OPERATIONS

This session instructs the User on how to operate the TVC while VERT-X is under Measurement status.

6.3. CHAMBER PUMP-DOWN OPERATIONS

This session instructs the User on how to initiate the vacuum in the VERT-X chamber. Safety measures are described.

6.4. OPERATIONAL SEQUENCE

To perform such measurements it is necessary to operate a sequence of operations, which might vary depending on the type of measurement performed.

This section instructs the User about the various operational sequences which are necessary to accomplish an Athena MAM characterization.

In the following an example is provided.

> Mask Setting.

In case a mask is mounted on the collimator, such activity shall be performed off-line, before the vacuum generation. Specific interlocks are foreseen to inform the Control System about the type of mask being installed. The Control System will flag the measurement session according to the Mask setting [NOM, SMALL].

> Metrology

Linear metrology switching on and initialization.

Tilt metrology switching on and initialization.

> Raster-scan switching on

Raster-scan trajectory planner:

- Tube inclination θ_x [-3 / +3 deg]
- Tube inclination θ_y [-3 / +3 deg]
- Raster Scan nominal velocity [1 / 60 mm/s]
- Raster Scan slew velocity
- Area of interest (module location/ whole area)
- Raster Scan encoders initialization

> Detector stage switching-on

Detector stage positioning

- X position
- Y position
- Z position

> Detector switching-on

Detector parameter setting

- Read-out mode [IMA, PC]
- Frame-time [0.02 / 1.0 s]
- Window [FULL, WIN1, WIN2]

> Source switch-on (warmup if needed)

Source parameter setting

- anode current [0, 100 mA]
- voltage [10, 50 kV]
- target [TARG1]
- filter [NONE, HIGH1, HIGH2]

X-ray beam diagnostic

- Wavefront sensor initialization
- Wavefront measurement and analysis
- Mirror alignment correction
- Wavefront measurement and analysis
- Realignment if necessary

> Direct beam characterization (shape, spectrum, stability over time, collimation).

> Exposure start

> Raster scan start

> Raster scan stop

> Exposure stop

6.5. HOUSE-KEEPING PARAMETERS

Time

Vacuum level

Vacuum Pumps health status

Gate valves status

Shroud temperature

Chillers temperature

Metrology HK (dx, dy, dz, tx, ty)

Tube inclination (thetaX, thetaY)

Raster scan velocity

Tube temperature

Raster Scan position (x, y)

Raster Scan safety

Raster Scan brakes

Raster Scan limit switches

Detector position (x, y, z)

Detector HK

Mask

Filter

Source HK (temperature)

6.6. EVENT PARAMETERS

The following parameters will be registered for each event by the detector in the form of a standard FITS event file binary table:

Time [0.01s]

Det-X [10 micron]

Det-Y [10 micron]

Energy/Channel [1 channel = 10 eV]

7. STORAGE AND DATA HANDLING

This section instructs the User on how to recover and analyze the data obtained from previous sessions, either on testing or measurement, including the recovery of telemetry data (environmental parameters, current absorption, status of interlocks, alarms, etc.).

8. ERROR LIST

This section includes the list of Errors that can be generated by the VERT-X Control System, including a short description and a recovery action.

PART B – THERMAL VACUUM CHAMBER

9. THERMAL VACUUM CHAMBER DESCRIPTION

This section includes the P&I, schemes, hardware list, equipment, etc. which fully describe the configuration of the Thermal Vacuum Chamber.

This section also includes the list of manuals of the equipment used. Such manuals are added as Annexes to the VERT-X User Manual.

This section also includes the description of the local control unit used to operate the Thermal Vacuum Chamber.

10. VACUUM GENERATION

This section instructs the User on how to operate the Vacuum Control System, in particular:

- the sequence of operations performed by the system to evacuate the vessel;
- the sequence of operations performed by the system to break the vacuum under safety conditions.

In particular, the section describes the operations that can be performed from the local control panel of the Thermal Vacuum Chamber.

Such operations are allowed by pre-defined, password protected accounts, by-passing the VERT-X control system.

11. THERMAL CONTROL

This section instructs the User on how to operate the Thermal Control System, in particular:

- Definition of set-points
- Monitoring & Data Handling

In particular, the section describes the operations that can be performed from the local control panel of the Thermal Vacuum Chamber.

Such operations are allowed by pre-defined, password protected accounts, by-passing the VERT-X control system.

12. THERMAL VACUUM CHAMBER MAINTENANCE

This section instructs the User on the Maintenance activities to be performed on the Thermal Vacuum Chamber.

PART C – RASTER SCAN

13. RASTER SCAN DESCRIPTION

This section includes the P&I, schemes, hardware list, equipment, etc. which fully describe the configuration of the Raster Scan.

This section also includes the list of manuals of the equipment used. Such manuals are added as Annexes to the VERT-X User Manual.

This section also includes the description of the local control unit used to operate the Raster Scan.

14. RASTER SCAN STATUS CONTROL

This section includes:

- The list of monitored functioning parameters (motor current absorptions, etc.)
- The list of monitored status parameters (temperature on the structure, interlocks, brakes, etc.)
- The description of how the above mentioned information are located on the local control panel of the Raster Scan

The section instructs the User on how to change Raster Scan status (Calibration, Test, Measure, Maintenance).

Such operations are allowed by pre-defined, password protected accounts, by-passing the VERT-X control system.

15. RASTER SCAN TRAJECTORY PLANNER

This section instructs the User on how to plan the trajectory of the Raster Scan.

16. RASTER SCAN MAINTENANCE

This section instructs the User on the Maintenance activities to be performed on the Raster Scan.

PART D – METROLOGY

17. METROLOGY DESCRIPTION

This section includes the electrical schemes, hardware list, equipment, etc. which fully describe the configuration of the Metrology.

This section also includes the list of manuals of the equipment used. Such manuals are added as Annexes to the VERT-X User Manual.

This section also includes the description of the local control unit used to operate the Metrology.

18. METROLOGY CALIBRATION

This section instructs the User on how to perform calibration activities on the Metrology.

19. METROLOGY MAINTENANCE

This section instructs the User on the Maintenance activities to be performed on the Metrology.