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HARPS

Vacuum System Design, Analysis, and Performance Report

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Table of Contents

Chapter 1: Introduction

1.1 Scope

This document summarizes and describes the **V**acuum **V**essel (VV) concept.

1.2 Documents

1.2.1 Applicable Document

AD-1	HARPS Technical Requirements Specifications	3M6-SPE-HAR-33100-0002	1.0	21/06/2000

1.2.2 Reference Document

RD-1	HARPS Vacuum Vessel Temperature Control System	3M6-TRE-HAR-33102-0005	1.0	28/02/2001

1.3 **Acronyms** (for this report)

AD	Applicable Document
AP	Atmospheric pressure (1013 mb)
CCD	Charge-Coupled Device
CF	Continuous-Flow Cryostat (= CFC)
ESO	European Southern Observatory
FDR	Final Design Review
HM	Hall de montage (assembly hall / OG)
ICD	Interface Control Document
L-Key	List Key (for pumping system components)
MF	Michel Fleury / HA-OG
MP	Michel Pichard / HA-OG
OG	Observatoire de Genève
OHP	Observatoire de Haute-Provence
RD	Reference Document
SB	Salle Blanche (flow-room 10'000 / OG)
SP	Spectrometer
Sx	Support Nr x / see drawing HA-VS-B12-F
SZx	Supporting Zone Nr x / see drawing HA-VS-B12-F
TBC	To Be Confirmed
TBD	To Be Defined
VV	Vacuum Vessel
VS	Vacuum System

Chapter 2: Vacuum Vessel

2.1 Vessel Design

Ref: AD-1 report

Drawing : HA-VS-A01-F (7.3-0) + HA-VS-B01-F (7.3-0) + HA-VS-D05-B

The **SP**ectrometer (SP) is enclosed in a double-wall Vacuum **V**essel (VV) with a fluid circulation in the gap between the walls, which avoids temperature gradient along VV.

1. A vacuum pressure of < $1x10^{-2}$ mb is permanently held in this VV during observation operations.

2. VV protects the SP against pressure variations, parasitic light, air temperature variations, vibrations, dust, humidity and earthquakes.

3. VV is composed of three different units (VV-1; VV-2; VV-3), of optimal length, to make the access easier to the SP during installation, optical alignment, maintenance and during transportation .

4. The SP is supported inside the VV at three points S1 + S2 + S3, fitted out with vibration dampers. Some of the benefits of this type of construction are:

   - To prevent mechanical stress transmission by VV to the SP.
   - To reduce thermal contact between VV and SP.
   - To damp 3.6m building vibrations (second damping level).

5. In the coudé-room of 3.6m, after the first testing period, once the VV will be closed (working position), it will also be supported at 5 points S4 to S8 (external feet), equipped with vibration dampers RUBLOC "Trisolator" (first damping level), to prevent vibration transmission from the coudé-room floor to VV.

6. The **C**ontinuous **F**low cryostat (CF) is fixed on the F1 VV flange.

7. The **D**etector **H**ead (DH) is fixed onto the SP.

8. CF and DH (= **D**etector **U**nit = DU) are linked up with diaphragm bellows and two flexible LN_2 pipes, avoiding vibration transmission between VV and SP.

9. Electrical connections of DH are achieved by feedthroughs on the F3 VV flange. The location of F3 is as close as possible to F1 to shorten the distance between dynamic output on DH and CCD pre-amplifier on F3 flange.

10. Scrambler / **O**ptical **F**ibers (OF) uses a feedthrough installed on F2 VV flange.

11. **PO**semeter (PO) uses a feedthrough installed on F5 VV flange.

12. F7 + F8 VV flanges are reserved for pumping system.

13. F4-1 + F4-2 VV flanges are dedicated to DH / camera adjustments and DH electrical connections. They allow access to the SP + DU devices and components.

14. F6 + F9 + F10 + F12 + F13 VV flanges are free for future evolution (necessary for additional feedthroughs)

2.2 Units description and Materials

Drawings : HA-VS-B01-F + HA-VS-D05-B

The **V**acuum **V**essel (VV) containing the SP is made up of three stainless steel units (quality = AISI 316L) composed of 2 stainless steel sheets and flanges.

- Thickness of the internal sheet = 6 mm.
- Thickness of the external sheet = 4 mm.
- Gap between the 2 walls = 21 mm
- Inside diameter of VV = 1038mm
- Outside diameter of VV = 1100 mm

1. VV-1 = VV head : this unit is supported at 4 points (feet) S4 + S5 + S6 + S7 on the ground of coudé-room (S4 to S7 equipped with "Trisolator" dampers) . These points include stops to reproduce the exact location of VV-1 in comparison with THK rails, after the installation of the dampers and then, returning onto aluminium shims, before dismantling operations (opening VV). The input / output flanges F1 to F12 are welded on this section.

2. VV-2 = VV cylindrical central unit : moving on wagons on THB floor-rails, 1 central-point S8 (VV-3 side) supported on the ground of coudé-room (S8 equipped with "Trisolator" dampers). VV-2 is screwed (+ pins) on VV-1.

3. VV-3 = VV rear cover unit : close the VV (F13 free flange on this unit). VV-3 is also screwed on VV-2.

2.3 Inside of the VV

Drawings : HA-VS-A01-F + HA-VS-B01-F

1. X-Y-Z axes definition for mechanical references (VV / SP / DU) is identical to X-Y-Z axes definition for SP optical reference (same axes + signs conventions). Zero point for these axes is the sensitive surface of CCD-chip

2. Welded supports (in VV-1 and VV-2) hold the SP on three points : S1 + S2 points on unit VV-1 and S3 point on unit VV-2.

3. The S1 + S2 supporting-points in unit VV-1 include guiding, positioning and stop systems, which carry out the position of the SP in comparison with X-Y-Z axes.

4. X-Y-Z reference for SP in unit VV-1 is the axis of flange F1. It is possible to set the reference-stops according to the relative position of DH / CF axis.

5. A +/- 5 mm length of stroke of positioning and stop systems are provided in all X-Y-Z axes. In case of dimension mistakes during the SP / DU / VV manufacturing, it could be still possible to increase this length of stroke by +/- 20 mm.

6. Once the SP has been taken out / in of the VV, it will be repositioned by the reference-stops.

7. Two linear guiding rails (L = 1750 mm) / INA type: LFS 52 FHEE- , screwed on the dedicated VV-2 welded-supports are used to move the SP in and out the VV. Two ball-bearing wheel runners are installed on both sides of the SP bench. These runners roll along the rails during SP setting. They are removed when the SP is in place on its 3 supporting-points S1 + S2 + S3.

8. Inside welds are polished and cleaned to reduce outgassing.

9. Inside surface of the VV stainless steel sheet is ground (220 grain) for outgassing and radiation reasons.

10. All inside surfaces are heated at a bakeout temperature of up to 150°C after a deep cleaning (grease scouring).

2.4 Outside of the VV

Drawings : HA-VS-A01-F + HA-VS-B01-F + HA-VS-D05-B

1. Because of the link between DH and CF, it is necessary to keep a good alignment and positioning between VV-1 / VV-2 and SP during all of assembly phase of HA. THK precision rails perform this alignment until SP is supported by the VV. These rails assure a temporary precision link from VV-1 to SP through the ground of coudé-room

2. To screw VV-1 + VV-2 + VV-3 units together, circular flanges are welded at each unit extremity.

3. O-ring seals (Viton quality) maintain vacuum-tightness between these units.

4. A reference system (pins) between VV-1 and VV-2 units will perform the positioning repeatability (accuracy +/- 0.1mm) during assembly and dismantling of the VV.

5. VV head (unit VV-1) has 4 feet, S4 to S7, supporting this unit on the coudé-floor. It has 13 welded flanges off different diameters (F1 to F12) for input and output feedthroughs :

    - 2 flanges ISO-K DN 250
    - 2 flanges ISO-K DN 160
    - 6 flanges ISO-K DN 100
    - 2 flanges ISO 40-KF
    - 1 flanges Special ø 151 mm / for CF (drawing HA-DU-A02-A)

    - ISO-K flanges (= klammerflansch) use standard claw clamps system.
    - ISO-KF flanges (= kleinflansch) use standard clamping rings.
    - Special flange for CF uses dedicated screws system.

    - O-ring seals (Viton quality) will assure the vacuum-tightness at flanges level

    See also list on document HA-VS / Flanges on Vessel : No_brides .doc + *HA-VS-D05-B* .dwg

6. The VV cylindrical central section (unit VV-2), is equipped with:

    - 2 supporting zones SZ1 + SZ2 for 2 wagons. The wagons assure the movement of this unit along 2 special precision "railways" THB rails (for placing the SP in VV).

    - 1 foothold S8 for working position (VV closed).

7. The rear cover (unit VV-3) has one flat supporting zone SZ3 for lifting VV when it is necessary to introduce the damper "Trisolator" for the foot S8. A special structure is developed to maintain VV-3 in vertical position during handling, before fixing it on VV-2 (closing VV before vacuum).

8. To avoid a thermal gradient along VV, a thermal circulating system pushes a fluid through the inter-wall gap of the 3 units VV-1 to VV-3, providing a thermal homogeneity of VV.

9. The circulation of the fluid is forced through a helical path. This path is achieved by welded rings between the two walls. This kind of construction spins the fluid all around the VV, from one side to the other. This fluid action minimizes the up and down, left and right temperature gradient along VV skins.

10. In HE, the VV will be surrounded with a thermal insulation box. This box, made from polystyrene-foam / aluminum sandwich panels, fixed on a frame, will be installed only at the end of the SP installation. To allow access to the SP during optical alignment and maintenance, it is easy to dismantle these panels.

11. The three units VV-1 to VV-3 are equipped with some “Jurgens” swiveling lift rings (lifting eyelets) for handling, transport and anchoring for earthquakes security straps.

2.5 Performance Estimate

The first calculated values of VV give the following results

1. With VV under vacuum (< 1 x 10^{-3} mb), the maximum authorized pressure values in the inter-walls of the units VV-1 to VV-3 can be AP + 1.44 bars. The minimum can be AP - 0.77 bar. These values are given with a safety margin of three. Usually, when the thermal fluid is circulating, the inter-wall pressure should never exceed AP + 0.2 bar.

2. When the VV inside pressure value changes from AP to < 1 x 10^{-3} mb, the maximum mechanical drifts of any VV parts are lower than ± 0.5 mm.

3. General mechanical precision of all important VV dimensions (X-Y-Z axes) will be better than ± 0.5 mm (still better for flange surfaces).

Chapter 3: SP installation kinematics

All these steps will be first adjusted and tested at OG, in assembly-hall flow-room (HM-SB), before being implemented in La Silla 3.6m coudé-room.

For handling and operating VS / SP / DU, it is planned to use the same mechanical devices and accessories at OG assembly-hall as well as at La Silla coudé-room.

The same ground THK rails (2 x 5m) are to be used at OG and La Silla.

Before starting installation and adjustment of optical elements on SP bench, the different motions and installation steps of SP in VV, as well as the units VV-1 to VV-3 connections, will be aligned, positioned and tested. The stops on S1 + S2 will be adjusted in comparison with DU reference axes (X / Y / Z). The stops on S4 to S7 will be adjusted and aligned with THB rails.

This method will avoid hazardous handling and allow necessary additional machining avoiding the presence of optical elements of great expense on the SP bench. Furthermore, is very important to handle optical elements in dust free conditions (flow-room switched on).

3.1 Step 1 / spectrometer outside VV

Drawing : HA-VS-B10-F

First step, used for the SP adjustments and tests during preliminary phase.

It allows adjustments and installation of all opto-mechanical parts as well as optical alignment.

1. SP installed in front of unit VV- 1, on three points S1 + S2 + S3, by means of three test supports. Unit VV-1 installed on the coudé-room floor on its S4 to S7 points (aluminium shims temporarily replacing "Trisolator" dampers). Earthquake security provided by straps through SP bench and under the THK rails.

2. Optical fibers, crossing flange F2 of unit VV-1, connected to their SP interface.

3. CF mounted (with a temporary test link-adapter) directly on DH / SP.

4. In this step, it could be necessary to have a special test set of cables to assure the DH + CF electrical connections to FIERA.

5. With this configuration it is possible to evacuate CF + DH, cool and operate CCD, connect all electrical cables and operate the whole SP.

6. At the end of this step, the transfer of the SP inside unit VV-1 is performed by the SP wagons system. The CF and his temporary link adapter (SP / DU) are dismantling for the next step.

3.2 Step 2 + 3 / spectrometer installation in VV

Drawing : HA-VS-B11-F + HA-VS-B12-F

After step 1 => step 2 :

1. SP is installed on points S1 + S2 (stops already adjusted) by means of its wagons and lift system. The control of the wagon motion is achieved by a rack and pinion system on the THK rail level.

2. Damper sheets are installed on S1 + S2 and the first SP wagon (VV-1 side) is lifted down and removed.

Step 3 :

3. SP is inserted in unit VV-2 (ball-bearing wheel runners at the beginning of the INA rails) . The second SP wagon is lifted down and removed, the unit VV-2 pushed along SP by means of the same rack and pinion system. At the same time, the SP runners roll along the inside INA rails and the unit VV-2 wagons roll along THK rails, carefully driven by rack and pinion .

4. Unit VV-2 is screwed (+ pins) on unit VV-1.

5. CF is connected to DH (diaphragm bellows and LN2 pipes).

6. Electrical connections of DH are achieved by feedthrough F3 of VV. Access to connectors of DH trough F4-1 and F4-2 flanges.

7. Stops S1 + S2 are moved back (a few mm) to avoid vibration transmission by a metal / metal contact with SP bench parts. At any time, it is possible to restore the initial position of the stops (reference position).

8. To limit the length of stroke of SP bench inside VV in case of earthquakes, some special dedicated stops are combined with the adjustment system at points S1 + S2. They are fixed at the correct position at this step 2. They limit the SP free deplacement in VV for X-Y-Z axes

9. Unit VV-3 can be connected and screwed to unit VV-2.

10. Now DU and VV can both be evacuated (all flanges closed) by means of the pumping system.

11. The test phase of the whole instrument HA can be started. The fine focus adjustment of camera / DH is achieved through flanges F4-1 + F4-2 + F6.

3.3 Step 4 / spectrometer under vacuum, inside VV

Drawing : HA-VS-B13-F

This step starts when the VV / SP / DU adjustments and tests are finished.

1. VV-2 wagons are removed. During this operation, aluminium shims of S4 to S8 VV-feet are swapped with "Trisolator" dampers. This handling is achieved by jacks, pushing against SZ1 and SZ3 zones.

2. The VV is now ready. The insulation box and the thermal control system can be installed around the VV.

3. Electronic racks as well as pumping system and all HA external devices now take their definitive locations in coudé-room and surroundings.

Chapter 4: Vacuum System

Drawing : HA-VS-C01-B (includes L-Key Nr)

4.1 Description of the Vacuum System

Two different types of vacuum will be necessary :

1. Insulation vacuum around the SP (inside VV) => primary vacuum.
2. Working vacuum for detector unit (inside DU) => high vacuum

4.1.1 Primary vacuum for VV

Drawing : HA-VS-C01-B

This vacuum is performed by two distinct systems.

System Nr 1:

- A "Pfeiffer DUO-35" two stage rotary vane pump / L-Key 02 allows to evacuate VV from atmospheric pressure to 10^{-1} mb in a few hours. A catalytic trap / L-Key 03, between pump and VV, improves the pumping and prevent oil contamination in VV. The pumping out of VV with this pump is only necessary after VV has been opened.

System Nr 2:

- A "Pfeiffer" modular pumping station "Turbo Cube" assures routine pumping out of VV (every 3 to 14 days) from ~1 mb to $< 5 \times 10^{-3}$ mb . This pumping unit combines a turbo-pump TMH 071 / L-Key 06 with an integrated controller and a diaphragm pump MD 4T / L-Key 05 (backing pump) in a closed housing.

1. All pumping operations are conducted manually by qualified people.
2. Only security system is automatic.

3. Pumping system never works during observation.

4. To avoid vibration transmission, a flexible pipeline / L-Key 08 is used as a link interface between primary pumping system and VV.

5. The pumping outlet as well as the AP-restore inlet use F7 VV flange.

6. Restoration of AP through inlet is done by introducing N_2 (or dry air) gas in VV. This action avoids introduction of H_2O in VV and SP optical parts. A 4 step manual valve is used to open / close the inlet. In this way it is possible to open the valve very progressively (avoiding rushes of air in VV and SP optical elements).

7. 1 Pirani pressure gauge PPT100 / L-Key 10 (covering range : 1x 10^3 mb to < 1 x 10^{-4} mb), fixed on F8 VV flange, allows to measure the pressure inside VV.

8. 1 Pirani pressure gauge PPT 100 / L-Key 09 (covering range : 1x 10^3 mb to < 1 x 10^{-4} mb), fixed on the interface between pumping flexible pipeline and pumping outlet, allows to measure the pressure before opening VV shut-off unit / L-Key 14.

9. The pumping control process operates with its own specific close-loop electronic controller.

10. A RS 232 link transmits pressure measurements, from DPG 109 controller to LCU. State of shut-off units could be transmitted too.

11. It is possible to open shut-of unit / L-Key 14 only when the pressure on gauge / L-Key 09 is lower than the pressure on gauge / L-Key 10.

12. In case of power cut during pumping, the rotary vane pump is automatically and immediately shut off. A security vane, shut off at the same time, stays closed until pressure is < 1 x 10^{-2} mb when the electrical power is automatically switched on again.

13. In case of power cut during pumping, the "Turbo Cube" is automatically and immediately shut off. It is necessary to manually restart this pumping system when the electrical power is restored.

14. In spite of the pump controller is being powered by UPS (**U**ninterrupted **P**ower **S**upply), an electrical shut-off unit / L-Key 14 allows rapid closing of the pumping outlet in case of sudden power cut, during the pumping operations. If necessary, it will also be possible to close shut-off unit / L-Key 04 to accelerate this operation, without inducing shocks in the VV.

15. All the shut-off units will be manually restored after any power cut.

16. To avoid vibration and heat springs, pumps for VV and DU as well as LN_2 main dewar will be installed outside the coudé-room floor, on the building floor.

17. The two ball-bearing wheel runners used to install the SP inside VV (by means of INA rails) are removed after this operation. The material for the three vibration dampers which equip SP supports S1 + S2 + S3 will be silicium or Viton, carefully selected to prevent outgassing.

18. To avoid any pollution of optical elements, no outgassing material is admitted in VV.

19. Any equipment (including SP) placed in VV should be free of trapped air pockets, clean and grease free. It is important to use vented screws to fix this equipment.

4.1.2 High vacuum for DU

This vacuum is performed by a Pfeiffer modular pumping station "Turbo Cube".

This station is identical to the one described in 4.1.1, point system Nr 2, except for the diaphragm pump (MD 4T replaced by MZ 2T, smaller size).

ESO provides a Pirani / Penning vacuum gauge "Pfeiffer" type PKR 251 (covering range : 1x 10^3 mb to < 1 x 10^{-7} mb) and an electromagnetic shut-off unit, both directly attached to the CF.

1. All pumping operations are conducted manually by qualified people.

2. A flexible pipeline is used to link pumping system to CF.

3. 1 pressure gauge (covering range : 1x 10^3 mb to < 1 x 10^{-3} mb), fixed to the interface between pumping flexible pipeline and pumping outlet, allows to measure the pressure before opening CF shut-off unit.

4. In case of power cut during pumping, the “Turbo Cube” is automatically and immediately shut off. It is necessary to manually restart this pumping system when the electrical power is restored.

5. In spite of the pump controller is being powered by UPS, an electrical shut-off unit allows to close the pumping outlet in case of sudden power cut during the pumping operations.

6. The pumping control process operates with its own specific close-loop electronic controller.

7. A RS 232 link transmits pressure measurements and state of shut-off units to LCU.

4.2 Performance Estimate

4.2.1 Vacuum Vessel

1. Insulation vacuum (primary) in VV < 1x 10^{-2} mb.

2. Working pressure is reached in a few hours.

3. VV leak + outgassing (without pumping) = hold time :

   Minimal : $< 1.2 \times 10^{-9}$ mb . l . s^{-1} . cm^{-2} (D = 3 days).
   Desirable : $< 2.5 \times 10^{-10}$ mb . l . s^{-1} . cm^{-2} (D = 14 days).

   D = time to increase pressure from 1×10^{-3} mb to 1×10^{-2} mb.

4.2.2 Detector Unit

1. High vacuum $< 5 \times 10^{-6}$ mb.

2. DU evacuated in ~8 hours (after a few months in service).

3. Same performances as ESO detector head standard.

Chapter 5: Manipulation of the Vessel and Safety Aspects

1. All heavy units are equipped with handling systems ("Jurgens" swiveling lift rings, lifting eyelets , hooks, wheels, handles, transport holes, …).

2. Movement and transport of these units are performed by trans-pallets, cranes, winches and jacks.

3. Inside OG flow-room (HM-SB) as well as inside La Silla HE, THK rails will be fixed on the ground to allow the movement of SP and unit VV-2 (same rails for SP wagons and VV-2 wagons).

4. The cross-section of these THK rails are very similar to railway rails. The wagon sliders (ball-re-circulating sliders) for VV-2 and SP are immobilized on the rails, all along the way, in two directions :

   - X-axis = vertical axis
   - Y-axis = horizontal-cross axis.
   - This system of motion provides high security during all handling of the assembly and adjustment phase of HA. Especially in case of earthquakes.

5. To secure wagons Z-axis (= horizontal axis / THK rails direction), a rack and pinion system, on rail level, provides also the same high level security. To immobilize wagons Z-axis, some stops are temporarily fixed on the rails during optical adjustment phase.

6. A specific set of lifting and moving devices (movement set) will be designed for the non standard motion of the SP and VV units.

7. During the designing of any sub-assemblies located inside VV, it will be essential to avoid trapped air pockets in any inside volumes (including optical, electrical, … components). To ventilate this volume, holes, slots and channels will be necessary.

8. Pump-out as well as atmospheric pressure (AP) restoration will be slowly operated to protect the contents of VV from pressure gradients.

9. To prevent earthquake damage , shock absorbers and stops equip the links between SP and VV.

10. VV will also be secured and firmly maintained on the coudé-room floor. To avoid VV turning up-side down it is equipped with security straps, anchored in coudé-room floor and linked to VV flanges by means of swiveling lift rings (same system as Coralie).

11. When the aluminium shims on S4 to S8 feet are swapped with "Trisolator" dampers, the screws linking the upper and lower parts of the feet are replaced by cable-rope through the holes. This method allows a slight displacement for the damper motions. In case of earthquake, these cables will stop the motion of the feet after a few mm of displacement.

Chapter 6: Thermal Homogeneity

6.1 Thermal Aspects

The VV is installed in the Harps Enclosure (HE).

HE is a separate room built inside coudé-room west. This room has its own thermal control (stability about 0.3 °K). Furthermore, 3.6m building has its own thermal regulation.

An insulation box (frame + foam-aluminum panels "Alucopan" / 60 mm) is installed in HE, around the VV, with a air thermal control system (fans + heating system).

This box will be installed only at the end, when all the test phase will be done.

- First step: (see also 2.4 pt 9 for details) the double-wall of the VV is used to homogenize its temperature. A thermal fluid circulating between the gap of the walls (along units VV-1 to VV-3) provides this effect.

- Second step: if necessary, we are keeping the possibility to add a fluid control system to regulate the temperature of VV, increasing his thermal stability.

The great stainless steel mass of the VV and the 200 liters of thermal fluid guarantee a good short term stability. This mass and its thermal inertial will filter high frequency temperature fluctuations (integrator effect) .

1. It is important to avoid any vibrations transmitted to the SP, when the thermal circulating system is running. The use of low speed circulator is foreseen.

2. To allow dismantling units, pipes link the three units together.

3. A set of temperature sensors, will assure a fine monitoring of temperature at different points. Monitoring points for VS will be installed on :

    - HE (3 points).
    - Circulating fluid
    - Outside skin of VV (> 6 points).
    - Inside skin of VV (> 4 points).

- SP bench (> 6 points).
- Echelle grating + grism + …
- Scrambler
- Camera
- DH + CF
- Other optical parts, … .

- Feedback (history, monitoring, …) of temperature measurements to LCU with RS 232 link.

6.2 Performance Estimate

See details in RD-1 report (VV Temperature Control System)

1.	HE (in coudé -room) set point absolute value :	16 °C ± 0.15 °C
2.	HE temporal fluctuations of temperature :	16 °C ± 0.15 °C
3.	VV set point absolute value :	17 °C + 0.5 / - 0 °C
4.	Temporal fluctuations of the SP temperature :	
5.	- Slow (week / month / year), accuracy / peak-peak :	< 0.1 °C
6.	- Fast (minutes, hours), accuracy / peak-peak :	< 0.02 °C
7.	Temperature gradient (homogeneity) across the VV :	< 0.3 °C / stable

These values are based on the results recently obtained with the Coralie SP installed in La Silla.

Chapter 7: Appendix

7.1 List of Drawings

Drawing No.	Issue	Date	Author	Description
HA-VS-A01-F	01	28.01.2001	MF / MP	GENERAL DRAWING / VV + SP + DU
HA-VS-B01-F	01	28.01.2001	MF / MP	PRELIMINARY DESIGN VV
HA-VS-B05-F	01	28.01.2001	MF / MP	FRONT STOP / SP
HA-VS-B06-F	01	28.01.2001	MF / MP	FRONT STOP / VV
HA-VS-B10-F	01	28.01.2001	MF / MP	KINEMATIC / STEP 1
HA-VS-B11-F	01	28.01.2001	MF / MP	KINEMATIC / STEP 2
HA-VS-B12-F	01	28.01.2001	MF / MP	KINEMATIC / STEP 3
HA-VS-B13-F	01	28.01.2001	MF / MP	KINEMATIC / STEP 4
HA-VS-B03-B	01	28.01.2001	MF / MP	SP-SUPPORTS
HA-VS-B04-B	01	28.01.2001	MF / MP	SP-RAILS
HA-VS-B08-B	01	28.01.2001	MF / MP	THK RAIL LINK
HA-VS-B11-B	01	28.01.2001	MF / MP	VV-1/ FEET
HA-VS-B12-B	01	28.01.2001	MF / MP	VV-2 / FOOT
HA-VS-B13-B	01	28.01.2001	MF / MP	RUNNER LINK
HA-VS-C01-B	01	28.01.2001	MF / MP	VESSEL PUMPING SYSTEM
HA-VS-D05-B	01	28.01.2001	MF / MP	ISO-K / FLANGES

7.2 List of annexed documents and data sheets (paper version only)

1. INA rails
2. THK rails and carriers
3. Trisolator dampers

7.3 Pictures included at the end of this report (with electronic version, also)

7.3.1 Document No_brides.doc / FLANGES ON VESSEL

7.3.2 Drawing HA-VS-B01-F / VV - PRELIMINARY DESIGN

7.3.3 Drawing HA-VS-A01-F / VS - GENERAL DRAWING

7.3.1 HARPS VACUUM SYSTEM : FLANGES ON VESSEL

ISO-K Standard : see drawing HA-VS-D05-B

No	Type passage	DN	Æ passage [mm]	Æ ext tube [mm]	Æ ext bride [mm]	Nb vis sur Æ	Æ vis M [mm]	Vis sur Æ [mm]	Æ ext flasque [mm]	Epais. flasque [mm]	Remarques
F1	Liaison DH-CF	151	151	160	187	24	4	176	187	10	Plan hadua02a (TBC)
F2	Scrambler entrée fibres	100	102.2	108	130	4	clamp	clamp	130	12	Plan haofa05a (TBC)
F3	Ampli + câbles DU	160	153	159	180	4	clamp	clamp	180	12	ISO-K / hadu… (TBD)
F4-1	Visite + réglage SP/DH – Y-	250	261	267	290	6	clamp	clamp	290	12	ISO-K
F4-2	Visite + réglage SP/DH – Y+	250	261	267	290	6	clamp	clamp	290	12	ISO-K
F5	Posemètre	100	102.2	108	130	4	clamp	clamp	130	12	Plan hapoa03a (TBC)
F6	Accès supérieur SP	160	153	159	180	4	clamp	clamp	180	12	ISO-K
F7	Pompes et mise air VV	40-KF									ISO-KF standard
F8	Pirani-gauge	40-KF									ISO-KF standard
F9	Réserve	100	102.2	108	130	4	clamp	clamp	130	12	ISO-K
F10	Réserve	100	102.2	108	130	4	clamp	clamp	130	12	ISO-K
F11	Sortie capteurs T + …	100	102.2	108	130	4	clamp	clamp	130	12	ISO-K
F12	Réserve	100	102.2	108	130	4	clamp	clamp	130	12	ISO-K
F13	Pompe / piège catalytique	100	102.2	108	130	4	clamp	clamp	130	12	ISO-K

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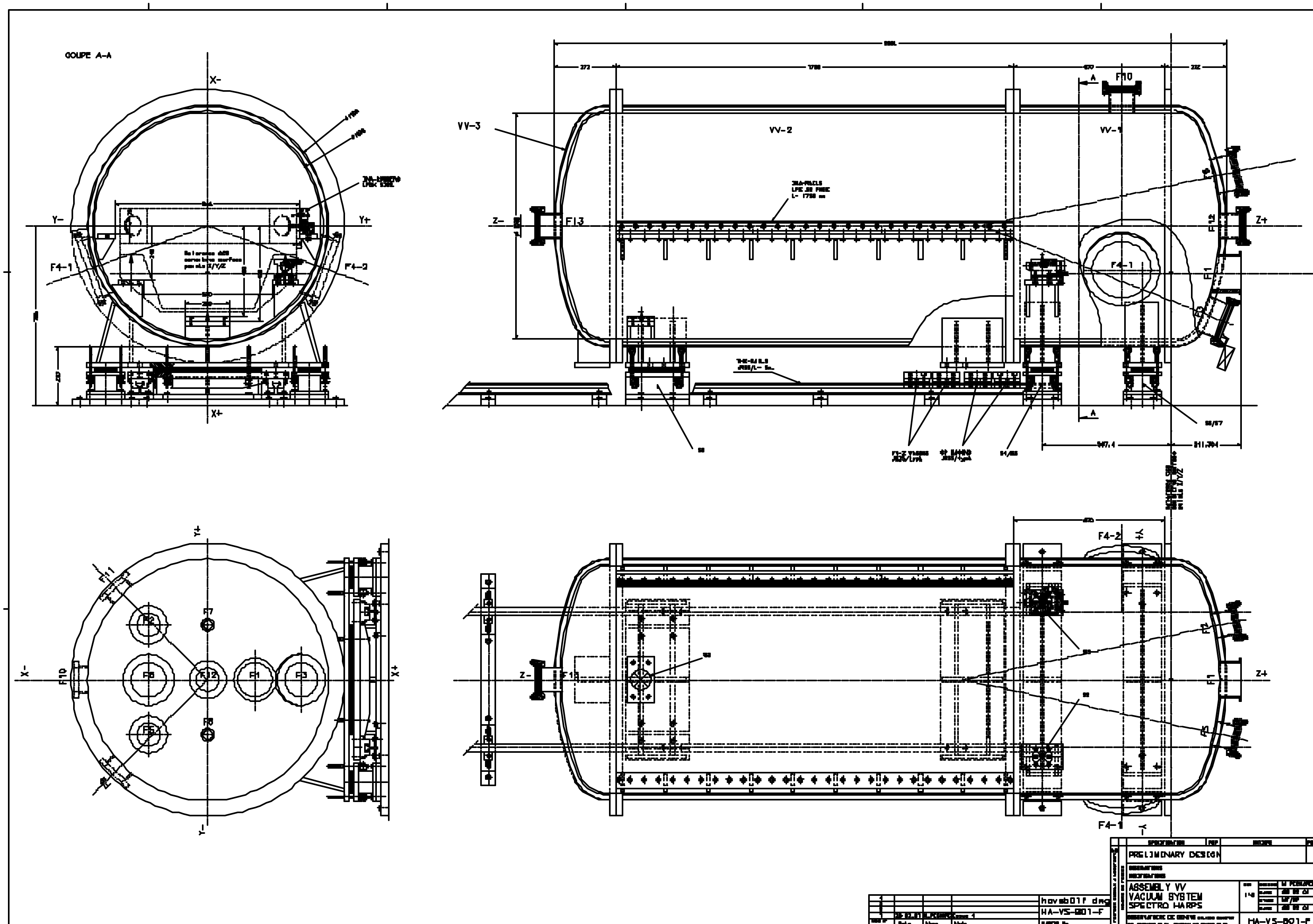
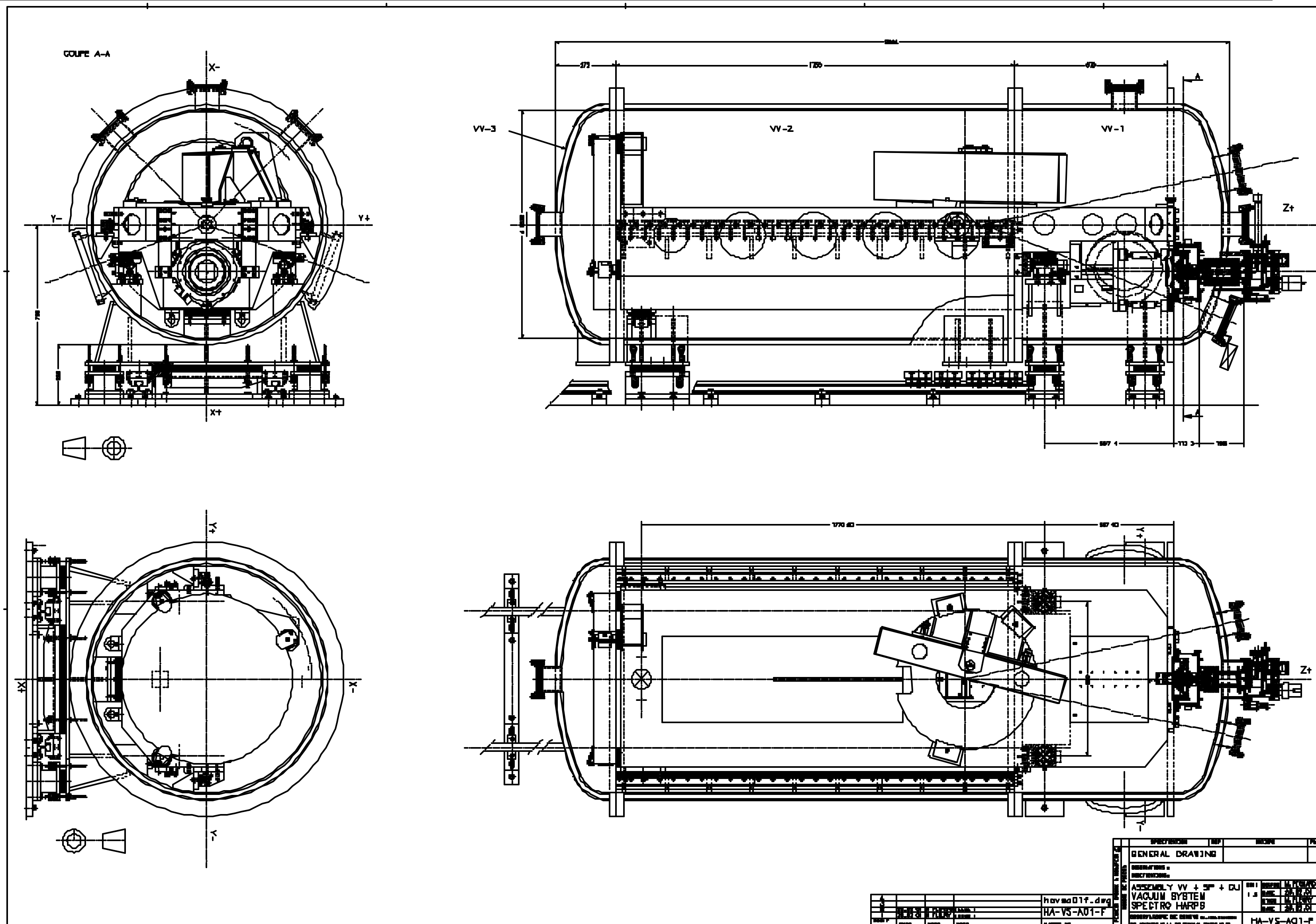
7.3.2 VV - PRELIMINARY DESIGN


COUPE A-A
X-
X+
Y-
Y+
F4-1
F4-2
VV-3
VV-2
VV-1
Z-
Z+
F13
F10
F12
F1
F4-1
F4-2
F7
F6
F8
F2
F12
F1
F3
F5
F11
PRELIMINARY DESIGN
ASSEMBLY VV
VACUUM SYSTEM
SPECTRO HARPS
HA-VS-001-F

7.3.3 VS – GENERAL DRAWING


COUPE A-A
X-
X+
Y-
Y+
VV-3
VV-2
VV-1
Z+
A
GENERAL DRAWING
ASSEMBLY VV + SP + DU
VACUUM SYSTEM
SPECTRO HARPS
1:5
havsa01f.dwg
HA-VS-A01-F
HA-VS-A01-F