ESO

European Organisation
for Astronomical Research
in the Southern Hemisphere

www.eso.org

VLT

FORS1

Gas Treatment of CCD Detectors on Paranal: Short Manual

Doc. No.: VLT-MAN-ESO-13121-4244

Issue: 1

Date: 20.04.2007

Author:	S. Deiries	20.4.07	[signature]
	Name	Date	Signature
WP Mgr:	G. Rupprecht	20.4.07	[signature]
	Name	Date	Signature
Head of Dep't:	D. Baade	20-4-2007	[signature]
	Name	Date	Signature

ESO, Karl-Schwarzschild-Str. 2, 85748 Garching bei München, Germany

CHANGE RECORD

ISSUE	DATE	SECTION/PARA. AFFECTED	REASON/INITIATION DOCUMENTS/REMARKS
1	20.04.2007	All	New document

TABLE OF CONTENTS

INTENTIONALLY LEFT BLANK

1 Scope

This document is written for the Paranal staff that has been trained in the described gas treatment by S. Deiries in January 2007 in case such a treatment has to be repeated.

2 Introduction

This document explains the gas treatment which is applied to improve the UV and blue quantum efficiency (spectral response) of a CCD detector.

3 Applicable and Reference Documents

3.1 Applicable Documents

None.

3.2 Reference Documents

None.

4 Pre-Installation and Preparation of the Treatment

4.1 Baking of Cryostat and CCD

⚠ The maximum allowed temperature for the CCD is 60˚ C.

⚠ The maximum allowed temperature for the sorption pumps in a bath cryostat is 100˚ C; in a continuous flow cryostat it is 70˚ C.

After the pumping of the cryostat is started, the temperature of the CCD is set to 60˚ C. The temperature of the sorption pump is also set to 60˚ C. This temperature is needed for the synthetic air treatment of the CCDs.

Figure 1: CRYMAC used for baking of the CCDs and the sorption pump(s) as preparation for the synthetic air treatment process

4.2 Layout of Vacuum Installation

Before the cryostat can be pumped the following vacuum installation should be done (see Figure 2):

a) Mount a KF40 T-Piece over a dry vacuum pump and install a vacuum sensor. At the other end of the T-piece an electromagnetic valve is mounted which closes the pipe against the pump in case of an electrical power failure.
b) At the other end of the electromagnetic valve another T-piece is installed.
c) One side of this second T-piece leads with a KF40 metal pipe to the cryostat valve and the other side the synthetic air bottle.
d) The pipe to the synthetic air bottle is reduced to a KF25 diameter.
e) Next follows a KF25 valve which can close the synthetic air stream from the vacuum pumping of the cryostat.
f) Between this valve and the synthetic air bottle there is an analogue manometer with a range of 0 – 1000 mBar and an overpressure valve which opens at 0.1 Bar overpressure compared with the ambient pressure.
g) The analogue manometer is later used to display the synthetic air pressure during the treatment. The valve at this manometer should always be open. It is only foreseen to be closed if the manometer leaks.

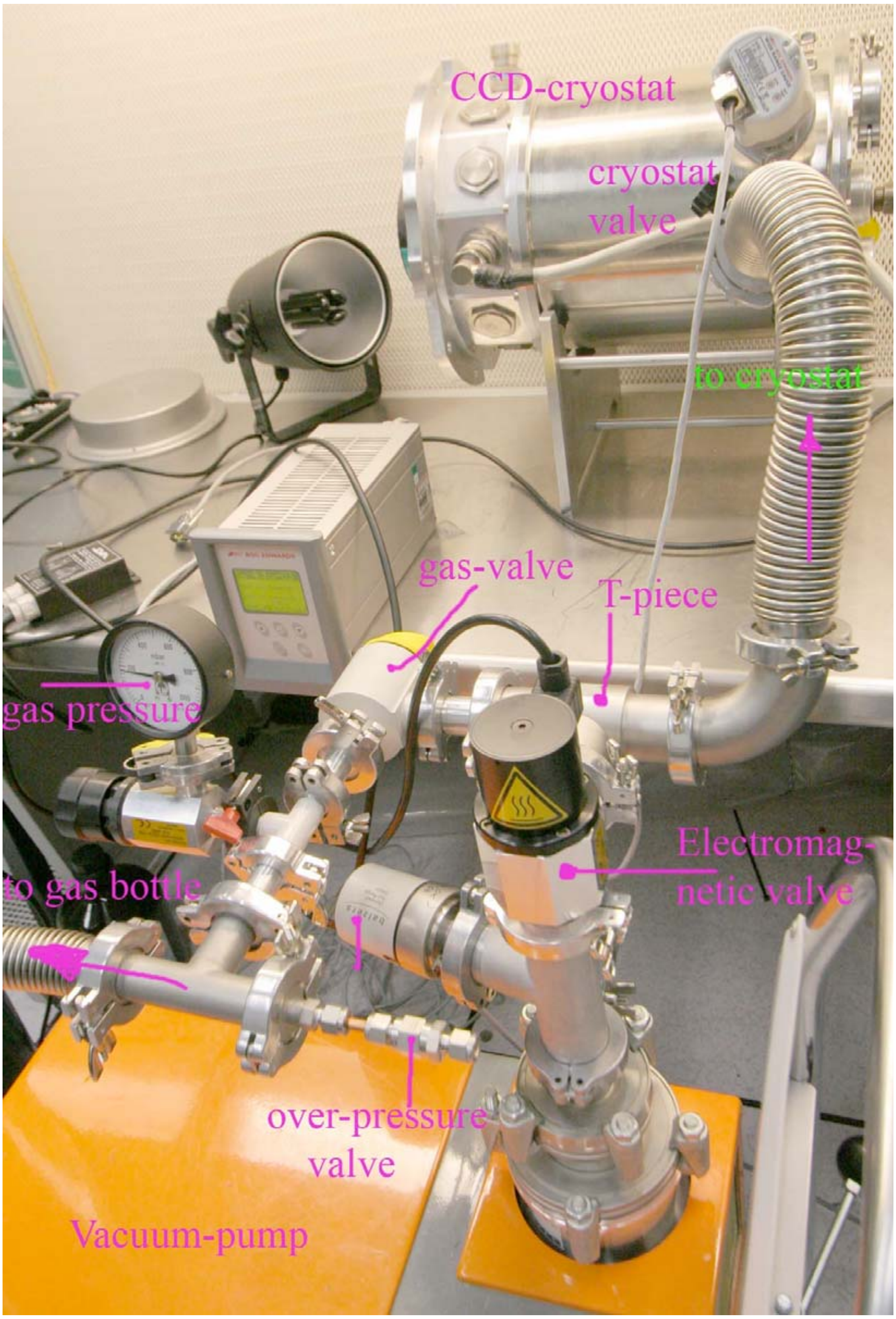

Figure 2: Vacuum installation

4.3 Preparation of the 200 Bar Synthetic Air Bottle

⚠ To operate the 200 Bar synthetic air bottle, use only an oxygen certified pressure reducer – otherwise an explosion may happen.

⚠ Carry the 200 Bar bottle in a suitable carriage or mount it to a heavy structure. A falling bottle could explode and/or injure persons.

⚠ Never open the bottle valve, if the pressure reducer valve is open.

The end of the pressure reducer has an adapter to the KF25 vacuum line and is connected to the pipe arrangement as seen in Figure 2.

Open the pressure reducer valve only carefully in order to avoid a too high pressure in the line. There is a 0.1 Bar over-pressure valve but this works only if the gas flow is not too high.

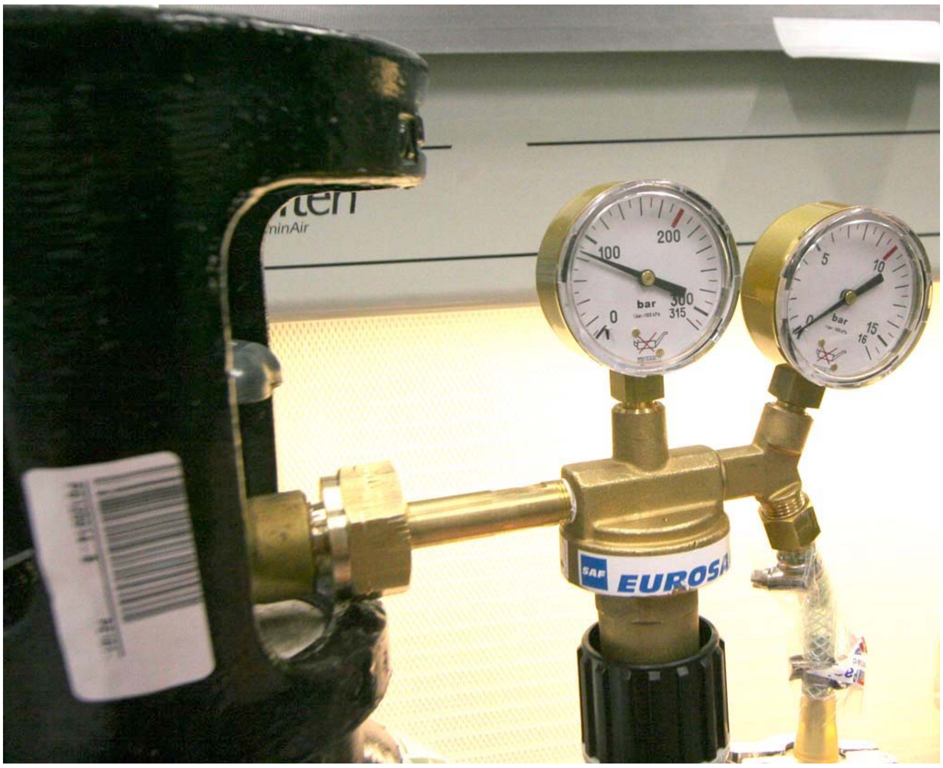

Figure 3: Detail of gas bottle and its oxygen pressure reducer

5 Synthetic Air Treatment

5.1 Precautions

Don't open the electromagnetic valve if the pump is running and there is ambient pressure in the pipe above:

- ➢ In this case switch off the pump and wait for 3 minutes, then open the valve.

Don't open the valve if there is vacuum above and the pump is not running:

- ➢ In this case start the pump and open the valve after 3 minutes at the earliest

5.2 Flushing the Gas Line

Close the gas valve (Figure 2) and open first the valve of the gas bottle. Then open carefully the valve of the pressure reducer until gas is coming out at the over pressure valve (see Figure 2).

⚠ Note that the pressure reducer valve works the opposite way as expected from opening and closing a standard valve!

Flush the line with a weak gas stream for approximately one minute and then close the valve of the pressure reducer.

5.3 Pumping the Gas Line and Later the Cryostat

If the cryostat has an inside pressure higher than 10 mBar, then open the cryostat valve now.

If the cryostat is already evacuated to better than 10 mBar, then leave the cryostat valve closed.

Read again the Precautions (5.1), then open the gas valve and the electromagnetic valve. Leave the cryostat valve closed.

Then start pumping and pump the whole gas line up to the pressure reducer.

If you reach inside this line (read the vacuum sensor above the vacuum pump!) a pressure better than 10^{-3} mBar, then the cryostat valve can be opened.

If the cryostat has a vacuum better than 1 mBar then open the cryostat valve now and pump the whole system down to a vacuum better than 6…9 x 10^{-2} mBar.

5.4 UV Light Flushing

⚠ Don't look into the UV-lamp without a proper protection goggle!

If the CCD and the sorption pump have reached a temperature of 60° C, the synthetic air gas treatment can be started:

1. Close the electromagnetic valve above the vacuum pump.
2. Open the valve of the pressure reducer carefully until you reach a value of approximately 800 mBar at the analogue manometer (see Figure 2).

3. Then close the pressure reducer valve AND the cryostat valve.
4. Use UV protective goggles.
5. Turn on the “UV discotheque lamp” and place it approximately 5-15 cm in front of the cryostat window. Let the UV-lamp shine for approximately 15 minutes onto the CCD detector, then turn it off. After approximately 7 minutes change its position in order to illuminate the CCDs homogeneously.

5.5 Pumping and Cooling Down

Now close the gas valve, open the electromagnetic valve and then open the cryostat valve. After this: start pumping.

The cool-down can be done after reaching a vacuum of approximately 5×10^{-3} mBar or better inside of the cryostat.

This cool-down can also be done some days later if a good vacuum (better than 0.1 mBar) is maintained inside the cryostat during this time.

5.6 Stability of Synthetic Air Treatment

According to our present knowledge this synthetic air treatment is stable over at least 2 months if the cryostat is kept under a vacuum better than 1 mBar. It may even be stable for several years under these conditions. Further investigations will be done in the followings months and years at ODT Garching.

The synthetic air treatment usually improves the UV and blue spectral response of an e2v CCD by approximately 10-30% (absolute). With MIT/LL CCDs only minor improvement has been noted.

APPENDIX: Abbreviations and Acronyms

This document employs several abbreviations and acronyms to refer concisely to an item, after it has been introduced. The following list is aimed to help the reader in recalling the extended meaning of each short expression:

CCD	Charge Coupled Device
Cryostat	Device to cool down a CCD head with its CCD detector mounted
e2v	e2v Technologies (CCD manufacturer http://e2vtechnologies.com)
FIERA	Name of the VLT Optical Detector Controller
HW	Hardware
LN2	Liquid Nitrogen
MIT/LL	Massachusetts Institute of Technology's Lincoln Laboratory (http://www.ll.mit.edu)
N/A	Not Applicable
ODT	Optical Detector Team
PRNU	Photon Response Non-Uniformity
QE	Quantum Efficiency
r.o.n	Read Out Noise
RMS	Root Mean Squared
Sorption Pump	A container inside the cryostat filled with zeolite or active charcoal for improvement of the vacuum
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
UVB	Ultra Violet-Blue (300 - 550 nm)
VIS	VISible (550 - 1020 nm)
VLT	Very Large Telescope
WS	Workstation

End of document