VIRGO COMPONENTS VACUUM COMPATIBILITY

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1 Introduction

The outgassing and contamination budget of components to be installed in the vacuum environment of VIRGO has a strong impact on the material selection, the cleaning, the storage, the mounting. It is the purpose of this paper to summarize the results of the first year of measurements and to review the selection and preparation procedures.

The specifications as taken from Final Design are:

- base pressure 10^{-8} mbar;
- partial pressure for hydrocarbons and their fragments: 10^{-14} mbar;
- total outgassing flow from components installed in the upper part of the tower: $10^{-3} \frac{mbarl}{s}$.

The general guidelines are:

- every part should be made of vacuum approved materials;
- there should be no blind holes or trapped volumes in the mechanical parts;
- a component is approved if the composing materials are approved and the cleaning procedures are approved;

- a part composed of different materials should be cleaned according to the most critical material.

2 Status of the art at July 1996

In the following the approved, the temporarily approved and the rejected materials will be presented. For the first two groups cleaning procedures will be defined. Cost estimation and delivery times will be reported. For all measurements performed in the Virgo Pisa Vacuum Lab the internal note numbers containing the details of the measurement of the outgassing rate and outgassing composition will be reported.

2.1 Approved components

Approved components are the ones which are recommended for VIRGO due to their low outgassing rate and negligible hydrocarbon contamination.

- metals (as deduced from tube measurements and literature)
  - stainless steel (304, 304L)
  - aluminium series 6000
  - OFHC copper
- cable insulation: for both materials there is negligible hydrocarbon contamination during baking
  - Kapton. note VACPISA 036; suggested cleaning is ultrasonic bath in isopropyl alcohol for 15 minutes, then 120 ^{0}C baking in vacuum; FEP layer should be absent
  - alumina. note VACPISA 037; as supplied from the factory
- vacuum sealants (to be used as glues mainly to fix the magnets): the below material should be used in the upper part of the tower only since there is no real way to clean it and the two components undergo aging. Moreover, there is hydrocarbon contamination above some tens degrees. It should not ber used in parts baked in situ. We should consider the possibility to fix magnets mechanically.

- VAC-SEAL, note VACPISA 048, with several days curing at room temperature; avoid contact with alcohol as suggested by LIGO experience

- magnets

  - samarium cobalt, note VACPISA 047; suggested cleaning is baking in vacuum at 150 ^{0}C. There is hydrocarbon contamination above a few tens degrees thus they should not be used on parts which must be baked in situ

2.2 Temporarily approved components

Two type of components:

1. Equipment built by UHV industries such as feedthroughs etc. which is is known to be good for UHV environments but has not yet explicitly tested for VIRGO contamination level

2. materials with good vacuum properties but not matching VIRGO requirements, thus waiting for a better cleaning method or a replacement

The list follows:

- electronics relates parts

  - ceramic and glass ceramic feedthorughs (Caburn/ICI and Ceramaseal under consideration) as supplied from factories
  - crimp contacts for electrical connections as supplied from factories; soldering should be avoided

- elastomers

  - Viton for blades and cross dampers

- magnets for the antispring

  - ferrite Phillips Ferroxdure 330, see notes VACPISA 046 and VACPISA 050; suggested method for cleaning is baking at 150 ^{0}C. Very well studied from the point of view of Barkausen noise. Non

negligible dust contamination. Slight hydrocarbon contamination at room temperature which becomes stronger with increasing temperatures. It is important to study both suitable alternatives and the possibility of sealing them

2.3 Rejected components

- Torrseal at room temperature, see note VACPISA 040; hydrocarbon contamination always present
- AML motors. see notes VACPISA 025 and VACPISA 041: there is lack of reproducibility of motor vacuum performances. Moreover, there is hydrocarbon emission during baking
- D.G. motors, see notes VACPISA 039: there was a strong contamination from hydrocarbon outgassing due to the use of not vacuum compatible materials and imperfect cleaning
- Krytox, see notes VACPISA 038: it has been suggested that fluorine compounds can deteriorate the mirror surface. and even at a few tens degrees there are several fluorine compounds in the outgassing spectrum
- filter prototype: the water break test was negative, there was oil contamination and the welding has been done on not cleaned parts

3 Costs and delivering times estimation for approved components

We briefly summarize the cost and the delivering times for the above components on the quantities relevant for VIRGO.

4 Seismic attenuation cascade outgassing

The details can be found in the note VACPISA 049. With the actual knowledges it is possible to assemble a cascade with an overall outgassing flow of

item	producer	cost	time (weeks
Kapton cabling	Raydex CDT, UK	$\leq$ 1 MLit/km	
alumina insulation cabling	Dipsol Chemicals, Japan	25 MLit	
VAC-SEAL	Physical Electronics, US	4 Mlit/g	
Samarium cobalt magnets	Magnet Developments, UK	see size	
flange+feedthrus	ICI/Caburn	4.1 ML	
flange+feedthrus	Ceramaseal	5 ML	
ferrite magnets	Philips	available	in Pisa

the order of $10^{-4}\frac{mbarl}{s}$, which is one order of magnitude lower than the one mentioned in the Final Design.

5 Cleaning procedures

For single parts the cleaning procedures have been specified above.

Complex parts should be cleaned acording to the specifications of the most critical component.

6 Handling and storing

Gloves should be used for handling, mounting and installation of cleaned parts. They should be changed when passing at a new stage.

Tools and parts in contact with clean parts during assembling and transportation should be cleaned ultrasonically with alcohol and dried.

Parts must be stored in bags made of aluminium foil or polyethilene plastic film.

Working areas for cleaning, packing, assembly must be covered with not contaminating foil just before starting work (do not use plastic beacuse it can undergo chemical reactions with some solvents).

7 Planning

The existing experimental facilities:

1. two chambers for small samples are available and working

2. a chamber for filter size samples is available and has been characterized

We are going to install a chamber equipped with a clean pumping system and a baking system to perform a preliminary vacuum baking of small samples. Calls for offers for a vacuum oven are being circulated.

Forthcoming vacuum tests include:

- ribbon cabling to tackle the problem of the stiffness of the large number of electrical connections on each stage

- a new UHV compatible motor and sealed motors for use in UHV

8 Collaborations

Both GEO600 and LIGO have agreed to share data and join efforts about the problems of vacuum compatibility.