# CKM Vacuum Veto System Detector Outgassing Studies

Technical Memorandum CKM-81

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## 1.0 Introduction

The outgassing rates of several materials for use in the CKM Vacuum Veto System (VVS) have been studied. These studies include single material tests as well as detector assembly studies.

## 2.0 VVS Prototype Outgassing Studies

A prototype vessel was assembled in order to house a section of a CKM detector ring. This section is equal to one-eighth of a full upstream detector ring. The scintillator material used in the prototype is Bicron 404 [1]. To complete the detector assembly, Tyvek 1060 and Lead are included. The outgassing rates of the PMT materials and feed-throughs are included in the overall outgassing rate determined. The total rate extrapolated for the VVS vessel is shown in [2]. The time period required to achieve the assumed steady state rate for the pumping system design is about two weeks. The results Figure 1.

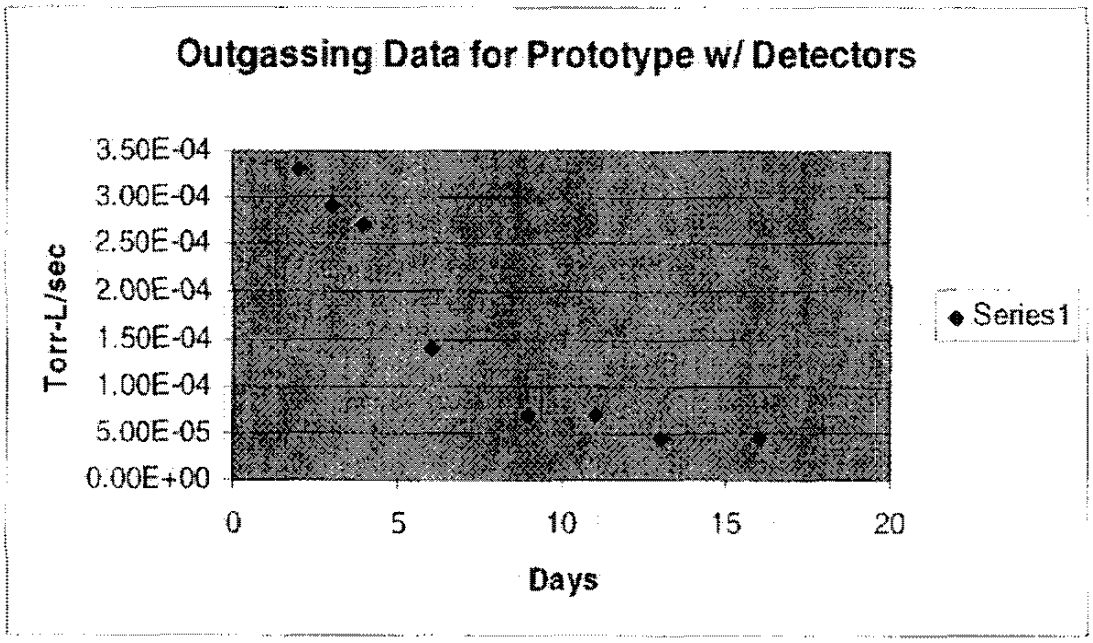



Figure 1. Prototype Outgassing Data

After subtracting the outgassing rate for the prototype vessel when empty, the outgassing rate of the Detectors and PMT's only is found to be 1.8E-5 Torr-L/sec.

## 3.0 Outgassing Test Chamber Studies

A Vacuum Chamber was prepared at the Proton Assembly Building at Fermilab in order to test several of the materials under consideration for the CKM detector. This Outgassing Test Chamber is large enough to house full size tiles as will be used in the detector assembly. A Residual Gas Analyzer was utilized to determine the types of gases that will need to be evacuated from the VVS in order to achieve the experiment pressure specification of 1.0E-6 Torr. The materials which dominate the detector assembly include the Scintillator, Lead, and Tyvek 1060 [3]. The types of Scintillator materials studied include Bicron 404 [1] and Polystyrene prepared by IHEP/Protvino. It is shown that the scintillator material outgassing rates are considerably larger than both the Lead and Tyvek. The outgassing rate of the Test Chamber while empty was measured before testing with the various materials. This 'empty vessel rate' is already subtracted from each of the rates stated below. The data points selected to calculate the outgassing rates are taken after 150 hours of pumping time for each sample.

### 3.1 Bicron 404 Outgassing Rate

The outgassing rate of one tile (1690 $cm^2$) of Bicron 404 [1] has been determined to be 4.7E-6 Torr-L/sec. The dominate gas seen by the RGA for this material is air. See Appendix A.1.

### 3.2 Polystyrene Outgassing Rate

The outgassing rate of one tile (1690 $cm^2$) of Polystyrene prepared by IHEP/Protvino has been determined to be 8.5E-6 Torr-L/sec. The dominate gas seen by the RGA for this material is air. See Appendix A.2.

### 3.3 Tyvek 1060 Outgassing Rate

The outgassing rate of one tile (1690 $cm^2$) of Tyvek 1060 [3] has been determined to be 8.1E-9 Torr-L/sec. The dominate gas seen by the RGA for this material is High Density Polyethylene. See Appendix A.3.

### 3.4 Lead Outgassing Rate

The outgassing rate of one tile (3380 $cm^2$) of Lead has been determined to be 2.6E-9 Torr-L/sec. The dominate gas seen by the RGA for this material is water vapor. See Appendix A.4. Note that the size of the Lead tile is double that of the other detector ring materials.

## 4.0 Summary

The outgassing rate of the VVS detector system used in the initial design of the vacuum pumping system is based on the prototype rate. The design rate is scaled by the Polystyrene to Bicron 404 ratio as well since the IHEP/Protvino scintillator will likely be used in the final detector assembly. The total outgassing rate assumed for the VVS detectors is determined in paragraph 2.1 of [2].

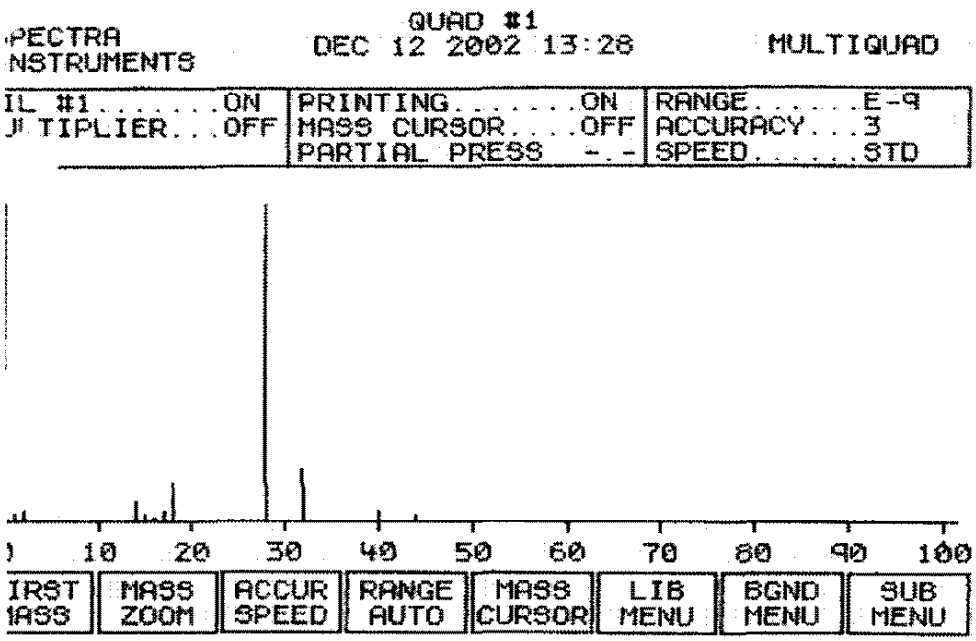
A comparison of the outgassing rates for the detector materials tested is summarized in Table 1 below. The surface area of the scintillator materials and the Tyvek is the equivalent of one tile. The size of the Lead tile is double that of the scintillator and Tyvek.

| Detector Material | Outgassing Rate per Tile |
|---|---|
| Bicron 404 [1] | 4.7E-6 Torr-L/sec |
| IHEP/Protvino Scintillator | 8.5E-6 Torr-L/sec |
| Tyvek 1060 [3] | 8.1E-9 Torr-L/sec |
| Lead | 2.6E-9 Torr-L/sec |

Table 1. Outgassing Rates of some VVS Detector Materials

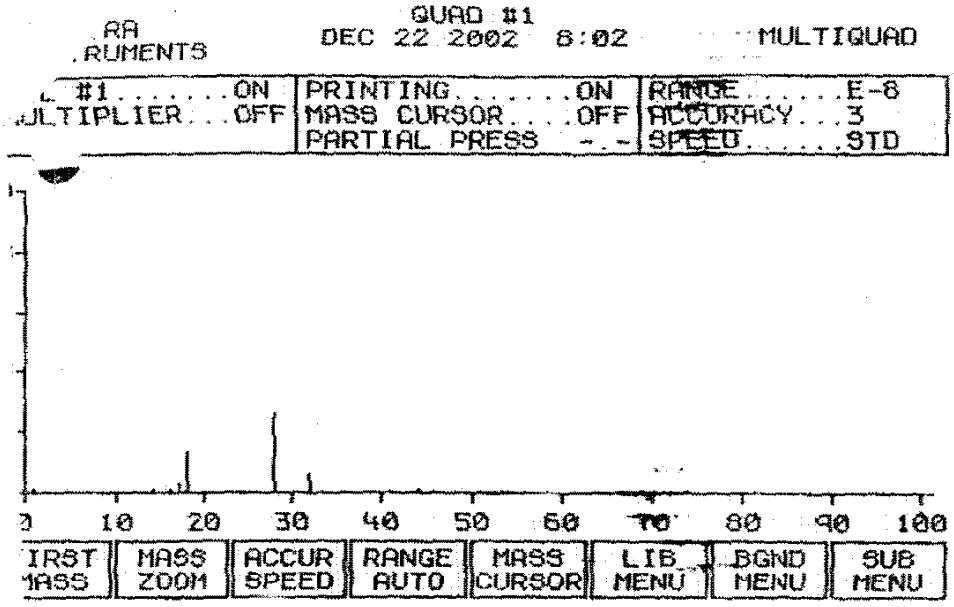
It is seen that the largest contributor to the total detector outgassing rate is the scintillator material.

## 5.0 Appendicies



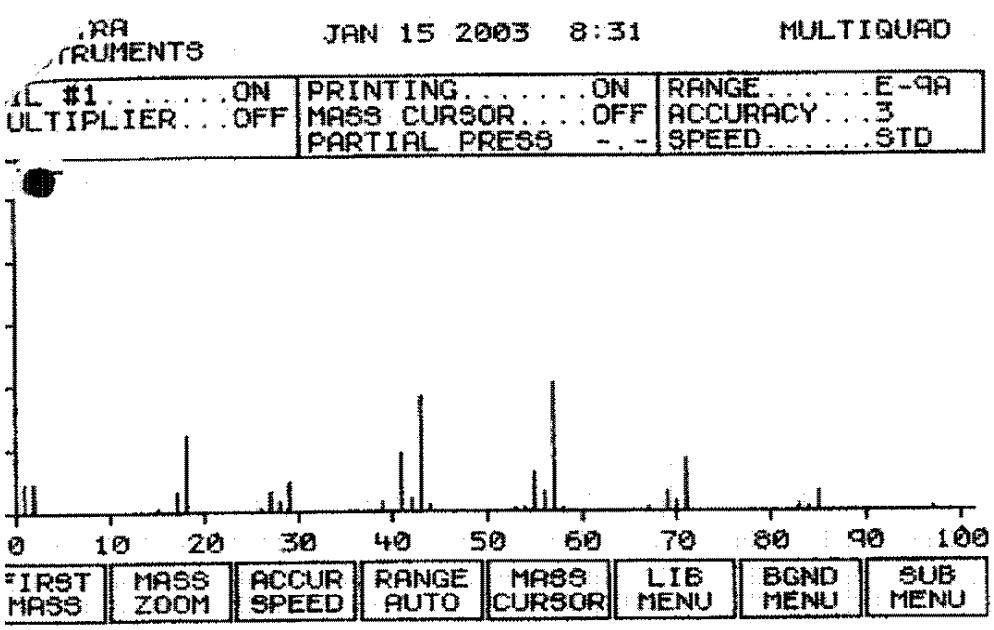

Bicron 404 tiles

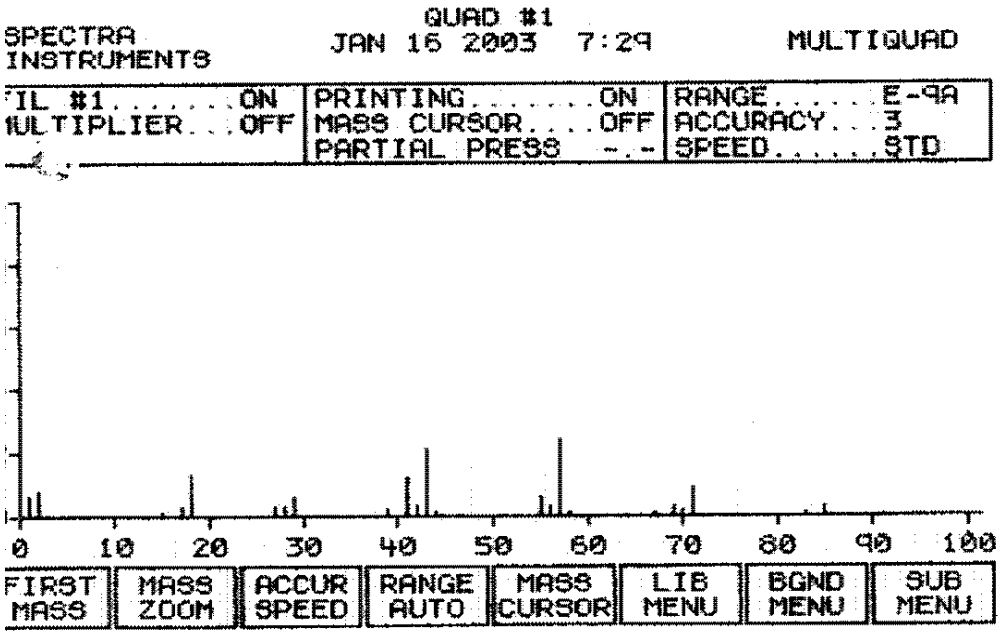
Appendix A.1.




ITTEP/Protuino Tiles

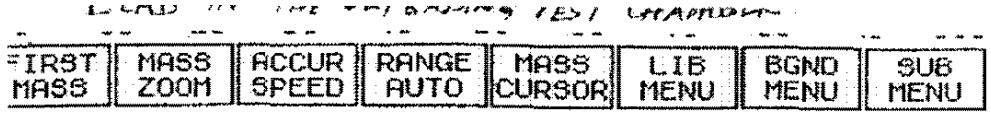
Appendix A.2




Tyvek 1060

Appendix A.3.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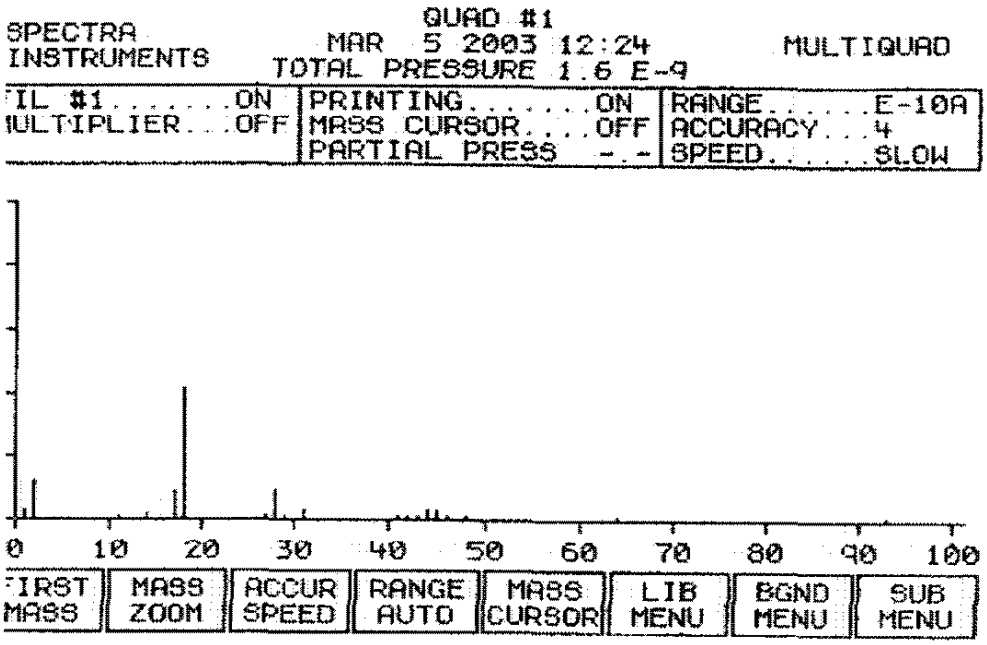
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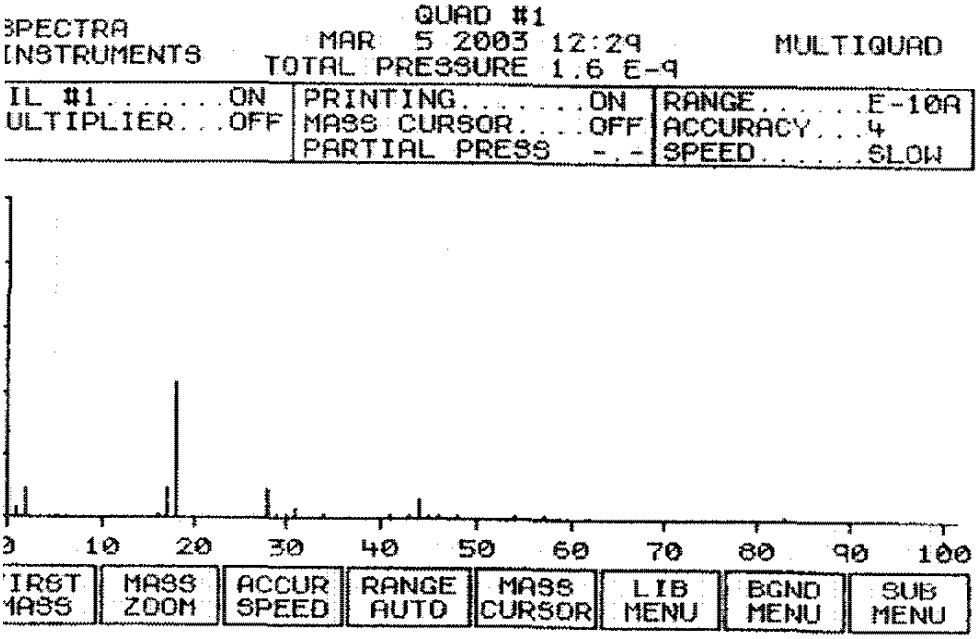
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FIRST MASS
MASS ZOOM
ACCUR SPEED
RANGE AUTO
MASS CURSOR
LIB MENU
BGND MENU
SUB MENU

## 6.0 References


1. Saint-Gobain Crystals & Detectors, http://www.bicron.com/

2. Allspach, "Vacuum Conductance Analysis of the CKM Vacuum Veto System," Technical Memorandum CKM-79, March, 2003

3. Dupont, Wilmington, DE, http://www.tyvek.com/