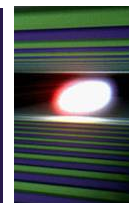


# First Experiences on Automated Venting Procedures to Avoid Particle Transport in UHV Vacuum Systems

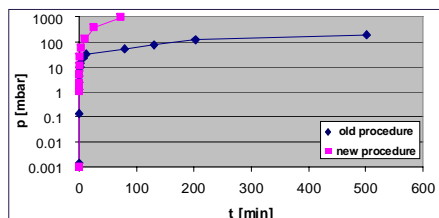
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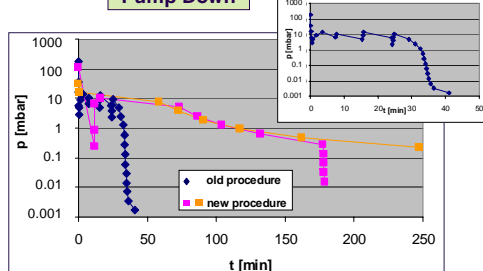
## Abstract

For particle free vacuum systems, as e.g. systems containing superconducting cavities to be operated at high gradients, special care needs to be taken during pump down and venting. Neither should be particles introduced into the vacuum system, nor should particles already present within the system be moved. A series of measurements to study the movement of particles in long tubes during pump down and venting using an in-situ vacuum particle counter has been performed. Based on these measurements a set-up using flow controllers, diffuser and pressure gauges has been developed to avoid introducing particles into the vacuum system as well as moving existing particles during pump down and venting. Operation can be manually as well as via a control unit. The electronics unit is an in-house development at DESY. It is usually connected to an oil free pump station. This set-up allows automated pump-down and venting of critical vacuum systems in a reliable and reproducible way.

## Venting

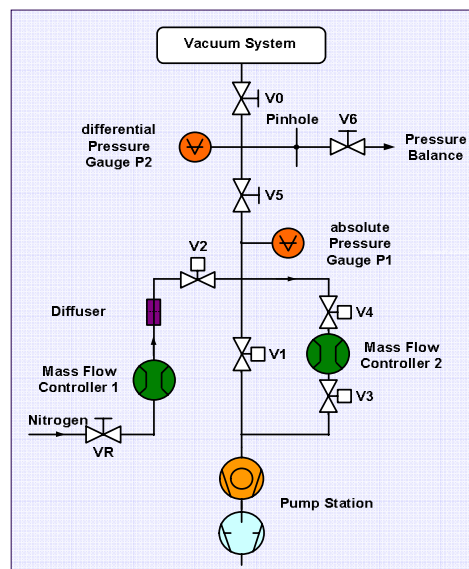


## Pump Down



## Motivation: Particle Movement in UHV Systems

- $p > 1$  mbar  $\rightarrow$  movement of particles observed
- $p < 1$  mbar  $\rightarrow$  no movement of particles observed
- $\Delta p > 1$  mbar (e.g. opening of valve, opening flange)  $\rightarrow$  movement of particles observed
- movement of particles mainly close to gas inlet / pumping port
- manual needle valve operation cannot easily avoid particle transport
- $\rightarrow$  develop an automated system with minimum intervention



## First Experience with a Cavity String (8 TESLA Cavities)

- reproducible procedures for venting and pump down
- solution for storage at changing air pressure without moving particles
- automated process with few manual operations (e.g. open/close some valves to vacuum system)
- set-up connected to pump station
- process time for **venting** reduced from 3 h to 1.5 h
- process time for **pump down** increased from <1 h to 3-6 h (safer than old procedure at critical pressure range)

## Key Elements of Set-Up

### Diffuser

- sinter filter to stop particles
- homogenization of gas flow

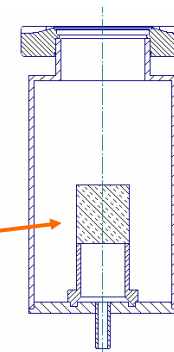
### Mass Flow Controller

- slow and uniform variation of gas throughput
- additional sinter filter to stop particles

### Pressure Gauges (Baratron)

- absolute pressure measurement
- differential pressure measurement to atmosphere

### Diffuser



## Improved Procedures

### Venting

- mass flow controller (MFC1) and diffuser
- slow and uniform increase of mass flow
- restriction of gas flow to 3 l<sub>0</sub>/min (50 mbar l/s) with N<sub>2</sub>
- differential pressure measurement to atmosphere

### Pump Down

- mass flow controller (MFC2)
- slow and uniform increase of mass flow
- restriction of gas flow to 3 l<sub>0</sub>/min (50 mbar l/s) with N<sub>2</sub>
- if  $p < 1$  mbar  $\rightarrow$  pumping through bypass line (V1)

### Storage at Air Pressure before opening

- storage at small overpressure (~100 mbar)
- pinhole for later pressure balance

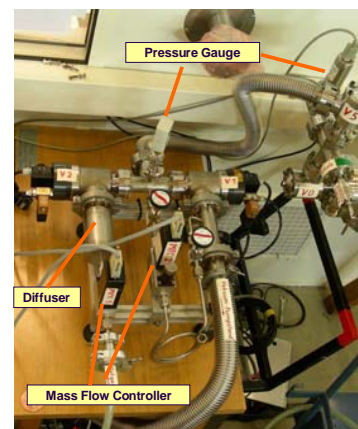
## Summary

- set-up for reproducible procedures developed
- safe pump down and venting possible without movement and /or introduction of particles
- decrease of process time for venting
- increase of process time for pump down
- opening flange after storage at air pressure  $\rightarrow$  device for pressure balance added

### References

D. Kostin et al., TUPP005, this workshop  
K. Zapfe and J. Wojtkiewicz: Particle Free Pump Down and Venting of UHV-Vacuum Systems; Proc. of the 13th Workshop on RF Superconductivity, Beijing, 2007

## Set-Up



## Next Steps

- improvements of electronics prototype unit/SPS program
- optimize process times to shortest duration under safe conditions
- operation of improved unit at cavity string
- production of sufficient units for oil free stations at DESY