HIGH PURITY VACUUM SYSTEM FOR ION BEAM ANALYTICAL PURPOSES

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The main part of the beam time is used for IBA measurements in the 5 MV Van de Graaff accelerator laboratory of our institute. Results of RBS and – by the advent of very thin window Si-Li detectors – PIXIE measurements are distorted in the presence of hydrocarbons. Though the old beam-line elements and magnet chambers were kept, a complete hydrocarbon free vacuum system has been built for the accelerator. The aspects of choosing dry pumps, turbomolecular pumps for measuring chambers, beam-lines and the main vacuum system of the single-ended machine are announced. In order too take into account the extreme hydrogen gas-load in determining right value of compression ration for the main vacuum turbopump, the gas conductance of acceleration tube has been measured. Details and results are presented. Possibilities to increase the lifetime of dry pumps were investigated. The vacuum related modification of the slit system and of beam current measuring system are introduced.

Questions: (audio quality poor in this session)

Roland Syzmanski (University of Melbourne): You obviously put a lot of effort into your turbo pumps to try to isolate the vibration. Why aren't you running ion pumps?

Bartha: We investigated other possibilities but we do not use ion pumps at all and also had to take into account our operations personnel, but as I mentioned, there is no vibration in our case.

Syzmanski: You talked about manpower, maintenance and the cost, but ion pumps just sit there.

Bartha: We had no experience with ion pumps. We had to decide very quickly because it was an eighteen month project including procurement.

Jan Klug (Ruhr-Universität Bochum: What is the connection between the turbo pump and the fore pump? We found that the metal hose that we got from Leybold reduced .... vibrations' very much. We found that most vibrations were not coming from the turbo pump, but from the fore pump.

End of questions

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The main part of the beam time is used for Ion Beam Analytical (IBA) measurements in the 5 MV Van de Graaff accelerator laboratory of our institute. Results of RBS and - by the advent of very thin windowed Si-Li detectors – PIXE measurements are distorted in presence of hydrocarbons. Therefore, a complete hydrocarbon free vacuum system has been built to the accelerator preserving the old beam-line elements and magnet chambers. The aspects of choosing dry pumps, turbo molecular pumps for the main vacuum system of the single-ended machine, beam-lines and the measuring chambers are announced. Taking into account the extreme hydrogen gas-load for the main vacuum system, the gas conductance of acceleration tube have been measured. Details and results are presented. Possibilities to increase the lifetime of dry pumps were investigated. The vacuum related modification of the slit system and of beam current measuring system are introduced.

Introduction

In recent years, many accelerator laboratories turned from fundamental research - preferring extremely high-energy charged particles - towards the applied one. In this area, ion beam analytics has been used expansively, which requires low or medium energy accelerators. In the 5 MV Van de Graaff accelerator laboratory of our institute the main part of the beam time is also used for IBA measurements.

It is commonly known that IBA analysis requires hydrocarbon-free vacuum system in order to avoid contamination of samples and precious radiation and particle detectors. Namely, deposits or layers of unwanted materials-like hydrocarbons- often result in false thickness or concentration values. In case of RBS samples a very thin layer of carbon, which is always present in the vacuum system of an average accelerator laboratory, concludes in unacceptable error. Hydrocarbon deposits on the very thin polymer window of modern Si-Li detectors used in PIXE decrease the transmission of the window.

Taking into account the increasing need for analytical measurements and the necessity of eliminating the presence of hydrocarbons, our laboratory applied for a fund for realisation of a very clean ion beam analytical laboratory, partly, by reconstruction of our old vacuum system. This huge program was carried out within the framework of Economic Competitiveness Operational Programme (ECOP), supported by the EU (Contract No: Contract 12/T05/BG). Its worth mentioning that the amount of money we could apply for purchasing was limited and we were obliged to do public procurement procedure. Both facts strongly constrained our possibilities during buying. As a consequence, we purchased only such parts and equipment which cannot be made by ourselves at all, like turbos, dry fore pumps, UHV-gate valves. It should be noted, that due to the restrictions of the public procurement procedure, we had to buy practically the complete system from the winner applicant. We had to cope with a third limiting factor, namely, the available period for purchasing and completion of project was too short, 18-month.

In the following, we shall describe what problems or tasks we had to solve, and how we solved them within circumstances mentioned before.

Construction of hydrocarbon free vacuum system

In the earlier vacuum system, sources of hydrocarbons were the rotary pump oil, the diffusion pump oil and the extremely large amount of BUNA-N O-rings. Residues of these materials had covered the inner surface of the whole beam transport tubes, of target and magnet chambers and of the acceleration tube.

Removal of hydrocarbons from the old system

Cleaning of beam transport tubes — due to their simple geometry — was relatively easy. Burned surfaces handled with emery paper or in rear cases with fluoric acid. The oil residues were removed by washing with petrol, with detergent dissolved in water. Than in every cases flushing with distilled water and finally, washing up with ethanol had been carried out. The last step decreases the adsorbed water. Target chambers were cleaned similarly, except the process used at burned surfaces before, because there was no burned residue in them. The last process is applied to new, homemade parts as well. New O-rings and flanges are cleaned with ethanol. This and more effective processes are announced in **[1].**

The most difficult task was cleaning the switching and analyser magnet chambers. These composed of big, flat, surfaces very close to each other, with mainly outside welded continuous welds. It was found to be impossible to remove any washing material from the vacuum side slots behind the welds mentioned. Because of the large size of the chambers, ultrasonic processes had been also excluded. The only possible process seemed to be cleaning with applying glow discharge.

The principle of this process: the output power of a 13.56 MHz frequency RF generator is connected through a matching network to a discharge electrode. The electrode is hold by a vacuum feed through, placed on a flange at one opening of the vacuum chamber. The chamber is kept under fore vacuum, in the range of 0.2 to 1.0 mbar, pumped at an opposite flange by a rotary vain pump, through a zeolite-filled filter. Near the discharge electrode, there is a metering valve, applicable to air inlet. Under these circumstances, the gas flow follows the inner surface, filling more or less evenly the whole vacuum space, and glow discharge appears surrounding the discharge electrode, what contains in high ratio of nascent oxygen. This oxygen oxidises the hydrocarbons, and the burnt gas is pumped out and absorbed in the zeolite trap. The photos of the arrangement are shown in **Fig. 1**. The 48 hours ultimate pressure of the chambers improved from $2\cdot10^{-6}$ to $3\cdot10^{-7}$ mbar.

Fig.1a

Fig.1b

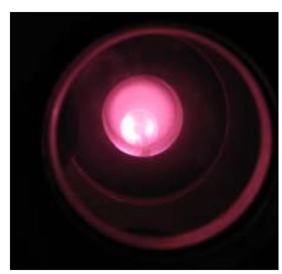

Fig. 1c

Critical mechanical dimensions in the vacuum system

At molecular flow, conductance C of a tube is proportional to the third power of its diameter, and inversely proportional to the length of it. If too small diameter tube or gate valve is connected to the throat of a turbo pump having larger diameter, the so-called effective conductance becomes too low, which results in much lower pumping speed, than specified for the pump. For the same reason it is also desirable to increase the cross section at T-shaped connecting part of a beam transport tube, as seen in **Fig 2.** The beam viewing plate also was built in the increased diameter connecting section. For similar reason, the connecting piece between the acceleration tube and main vacuum turbo pump is as short and has as large diameter as possible. It is shown in **Fig. 3.**

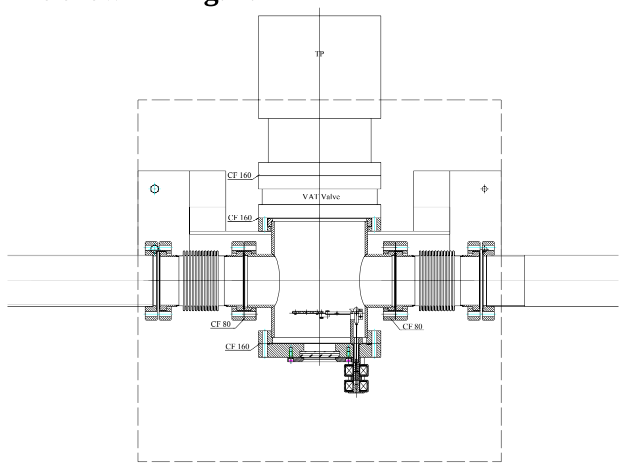

Fig. 2

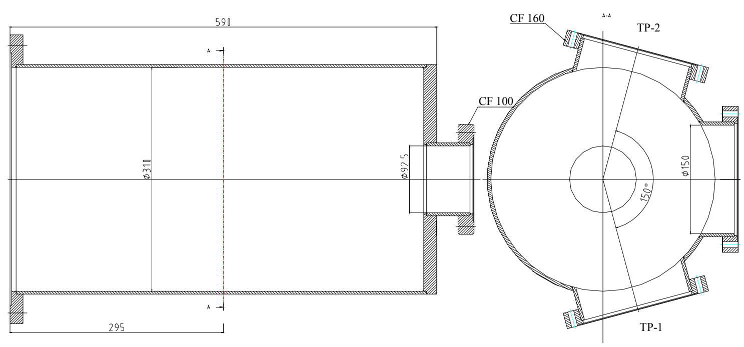

Fig. 3

Vacuum sealing, gaskets and feed-through

In the old vacuum system BUNA-N O-rings, Wilson-sealing (the moving one with greasing) and many of hygroscopic plastics were used everywhere. Probably the most labour consuming was changing of them.

Permeation for air at BUNA-N O-rings is $1 \cdot 10^{-7}$ torr liter/sec/linear cm, and at VITON it is $1 \cdot 10^{-8}$ torr liter/sec/linear cm, and is much more less if VITON O-rings are replaced with metal gaskets **[2].** In our new vacuum system about 98% of old BUNA-N O-rings have been changed to metal gaskets, and the remaining 2% to VITON. The circumference of VITON seals was also minimized.

Glass window of beam viewing plates is sealed with indium. Instead of wrapping the ends of the indium wire pressed from indium granules, the wire is placed by the drawing in **Fig.4.** resulting in very leak tight sealing. The old Wilson sealed moving part was eliminated here with a mechanism, activated by magnetic force, outside of a vacuum tightly welded stainless steel cylinder, emerging from the flange.

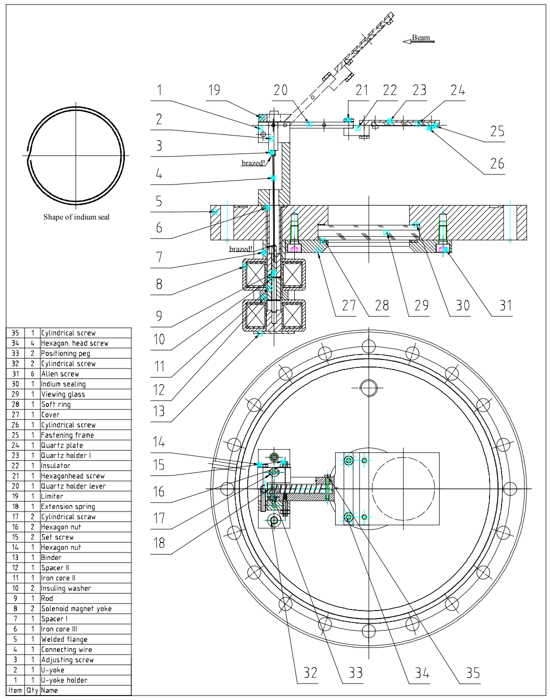

Fig. 4

The direct slit (object slit) system of the analyzer magnet was completely redesigned. The old, Wilson-sealed, water cooled slit system replaced by an air-cooled one, using edge-welded bellows to provide movability and vacuum separation. The insulator is made of an inoperable ceramics transmitter tube, vacuum brazed to the flange. The assembling drawing is shown in **Fig.5.**

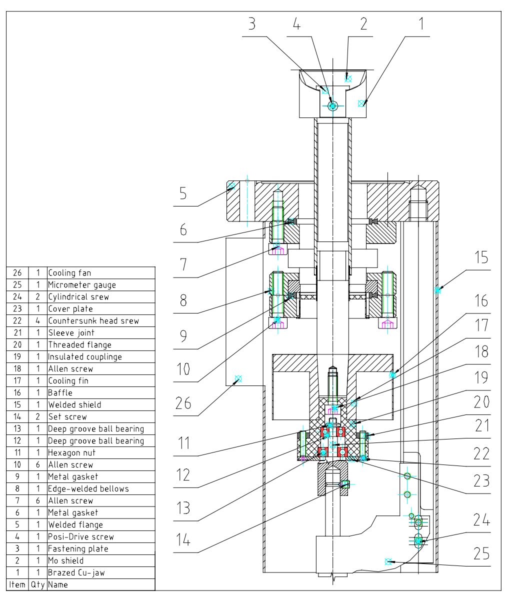

Fig. 5

The so-called retractable direct quartz (it follows the object slit) is illustrated in **Fig.6.** It is made of a modified edge welded vacuum bellows separated flapper valve (Type No.:SA0100PVQF)**.** The object slit elements shadow significant part of the direct quartz plate, protecting it from heat overload. Contrary this fact, it can be used only in a few tens of second period.

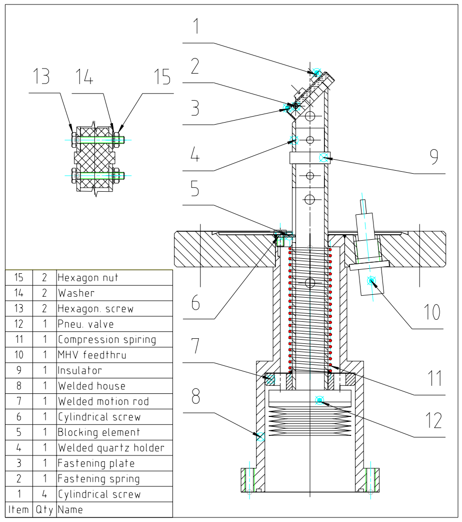

Fig. 6

Vibration caused by pumps

The vacuum stages of the beam transport and that of proton microprobe were built with TMU 400 MP magnetically levitated turbo molecular drag pumps and with XtraDry 150-2 two stage piston pumps, as is shown in **Fig.7**. The scanning proton microprobe (SPM) is a very vibration sensitive equipment. To avoid picked up vibrations, a vibration dumper was placed between the target chamber of SPM and its turbo pump (**see Fig.8**). During tests it appeared that vibrations are coming from the piston fore pumps, so the vibration damper has been removed (**see Fig. 9)**, and bellows of the fore pumps were vibration damped.


Fig. 7

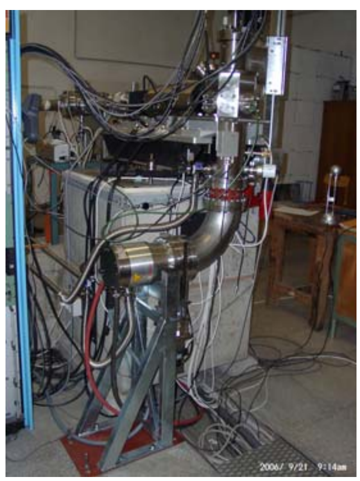
Fig. 8


Fig. 9

The main vacuum system is built with two TMU 521 PN turbo molecular drag pumps and two Busch Fossa 0030 three stage Scroll pumps, as seen in **Fig. 10**. These turbo pumps have to fulfil unusual requirements. It is not so well known, that in general, turbo pumps have very low compression ratio for H_2. In our Van de Graaff the main gas load for these pumps is H_2 coming from the ion source, through the acceleration tube. The TMU 521 PN is almost the only type of turbo pumps which has a compression ratio of $5 \cdot 10^6$ for H_2. For He_2 the compression ratio is $5 \cdot 10^7$.

In order to save fore pump life time in steady state, one of the scroll pumps is switched off. In case of the beam line vacuum stages we also using common fore pump for the different turbo pumps (**see Fig.11.**). XtraDry pumps operated at decreased speed, when vacuum became normal.

Fig. 10

Fig. 11

Vacuum conductance measurements of accelerating tubes

In a PVA-cemented glass accelerator tube the main sources of gas load are the ion source gas, the out-gassing of elastomers and adhesives. In practise, the most significant contributor is the ion source gas. In our machine, an RF ion source is used, consuming 2 to 6 cm^3/h gas, mostly H_2 and He_2.

Section seen in **Fig.12.b**, containing different diameter apertures and openings, is repeated 8 times in our acceleration tube with a total length of 4m. The too big tube length-aperture ratio suggests that the vacuum conductance might limit the efficient gas removal near tube entrance.

A method is announced for measurement of vacuum conductance in **[3]**, what is based on comparison of pressure drops across a comparison aperture and the acceleration tube to be measured, where the conductance of the aperture could be exactly calculated.

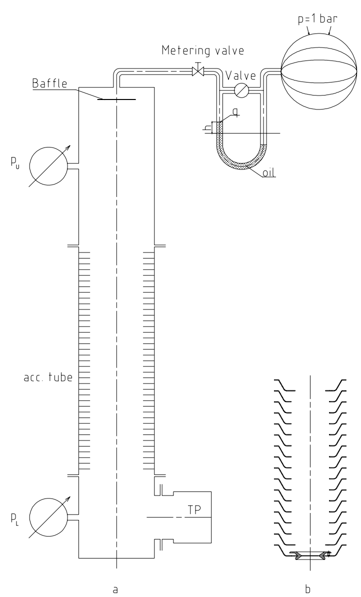

Fig. 12

We applied a different method, shown in **Fig.12.a** . The plastic ball on the right side has been filled with N_2 or H_2. The vacuum conductance depends on the species of gases, thus, measurements were carried out both for N_2 and H_2, respectively. The ball was kept with loosen wall in order to ensure 1 bar pressure. By means of the U-tube device and the Metering valve we can determine the throughput q_{pV} at the intake port of the cup above the acceleration tube, measuring the $t_2 - t_1$ period, supposing N_2, by the followings:

$$q_{pV_N} = \frac{p \cdot V}{t} \qquad 1.1$$

where $V = h \cdot q$, h is the height increase of the oil column between t_1 and t_2, $t = t_2 - t_1$.
On the other hand, the throughput of the acceleration tube is:

$$q_{pV} = C \cdot (p_U - p_L) = \Delta pC \qquad 1.2$$

If there is no out gassing from the elastomers and adhesives, $q_{pV_N} = q_{pV}$. As it is not the case, the residual gas pressures were also measured without inlet gas, and signed by p_{U_0} and p_{L_0} . Diminishing p_U and p_L with these pressures, results in a more realistic, gas specific conductance, C_N . Assigning the relevant throughput with q_{pV_N} , the following formula can be written:

$$C_N = \frac{q_{pV_N}}{\left(p_{U_N} - p_{U_0}\right) - \left(p_{L_N} - p_{L_0}\right)} \qquad 1.3$$

where p_{U_N} , and p_{L_N} are the pressures measured at the upper and the lower end of the acceleration tube at N_2 intake.

For the C_H conductivity referred to H_2 gas:

$$C_H = \frac{q_{pV_H}}{\left(p_{U_H} - p_{U_0}\right) - \left(p_{L_H} - p_{L_0}\right)} \qquad 1.4$$

where p_{U_H} , and p_{L_H} are the respective pressures at H_2 intake.

A baffle helps the even pressure distribution around the inlet of gauge measuring pressure p_U .

The different phases of the measurement are arranged in Table 1. The warning in step 5 should be taken very seriously! Usage of bad quality metering valve or roughly opening it also should be avoided!

Table 1

Step	History	Met. Valve	Valve	Time
1	Met.valve disconnected from acc. tube inlet, flushed thru U-tube	open	open	1-4 h
2	Equal U-tube oil levels, 1bar at Met. Valve. Acc. tube pumped down to ultimate vacuum	closed	open	48 h
3	Desirable throughput establishes	adjusted	open	10 min
4	T_1 is logged	unchanged	close	--------
5	Significantly increased oil level and T_2 logged. Beware! Too long T, oil gets into acc. tube!!!	unchanged	closed	10-30 min
6	Process finished	closed	open	~53 h

It is obvious that the dominant part of time is spent with evacuating the acceleration tube to ultimate pressure. If, as usual, it is kept continuously at high vacuum, the measurement time decreases significantly.

Measured input data and results are collected in Table 2.

Table 2

Ultimate pressures	p_{U_0} 7.3·10^{-6} *mbar*	p_{L_0} 3.8·10^{-7} *mbar*				
	p_{U_N} *mbar*	p_{L_N} *mbar*	$t = t_2 - t_1$	$V = h \cdot q$	q_{pV_N}	C_N .
Pressures at N_2 intake, at t_1	3.95·10^{-6}	9.3·10^{-7}	450 *s*	0.5 *cm*^{3}	1.11·10^{-3} $\frac{mbar \cdot l}{s}$	35.07 $\frac{l}{s}$
	p_{U_H} *mbar*	p_{L_H} *mbar*			q_{pV_H}	C_H
Pressures at H_2 intake at t_1	6.34·10^{-6}	2.22·10^{-6}	220 *s*	0.5 *cm*^{3}	2.27·10^{-3}	41.57 $\frac{l}{s}$

Conclusion

The project has been successfully completed. Vacuum levels are in good agreement with the expectation. The conductance of the acceleration tube for H_2 is acceptable. Certain parts of the vacuum system have not been baked yet. Baking probably further improves vacuum.

References

[1] B. J. J. Slagmolen, T. Slade, C. Mow-Lowry, AIGO Vacuum Part Cleaning Process, ACIGA internal report, Version 1.2, 5 February 2004.

[2] Phil Danielson, A Journal of Practical and Useful Vacuum Technology, www.vacuumlab.com

[3] H.R.McK. Hyder. Vacuum conductance measurements of accelerating tubes Nuclear Physics Laboratory Report Ref.37/72, Oxford University

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Contents

Removal of hydrocarbons from the old system

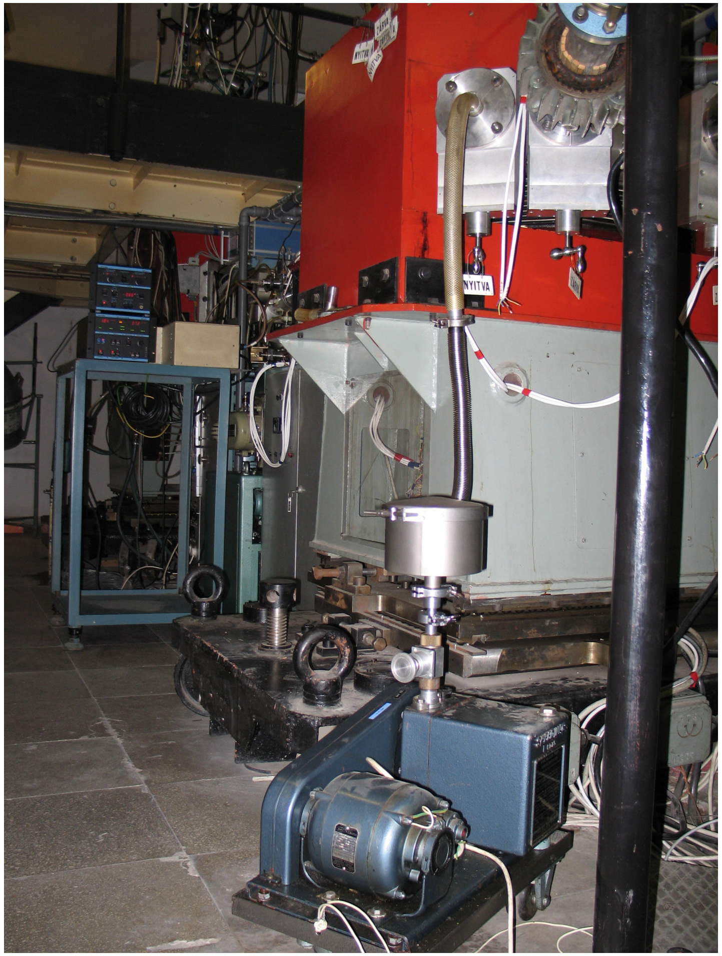
- **Types of contamination**
  - Burned hydrocarbons
  - Soft hydrocarbons
  - Other kind of dust
- **Cleaning of beam transport tubes**
  - Emery paper
  - Detergent dissolved in hot water
  - Distilled water
  - Ethanol (for new parts too)
- **Difficulties with cleaning of magnet chambers**
  - Composed by big flat sheets close to each other
  - Vacuum side slots behind continuous weld outside
  - Chamber removal from iron yoke complicated
- **Cleaning by glow discharge**
  - Principle: producing nascent oxygen, burn off hydrocarbons
  - Conditions: adjusted air inlet at one end, pumping the opposite one
    - inlet side pressure 0.2 to 1.0 mbar
    - matched 13.56 MHz RF frequency driving
    - high RF power
  - Trapping of output gasses

Removal of hydrocarbons from the old system

- The high power 13.56 MHz generator

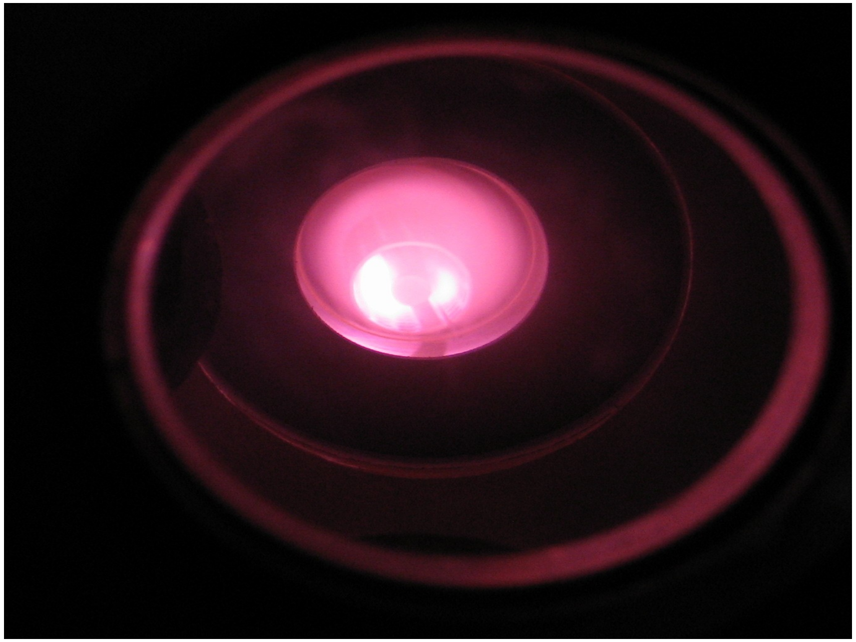
Removal of hydrocarbons from the old system

- Pumping out burned gasses, zeolite trap



Removal of hydrocarbons from the old system

- The glow discharge with view of discharge electrode



Removal of hydrocarbons from the old system

- **Result**

  48-hours ultimate pressure improved:

  from $2 \cdot 10^{-6}$ to $3 \cdot 10^{-7}$ mbar

Critical mechanical dimensions in the vacuum system

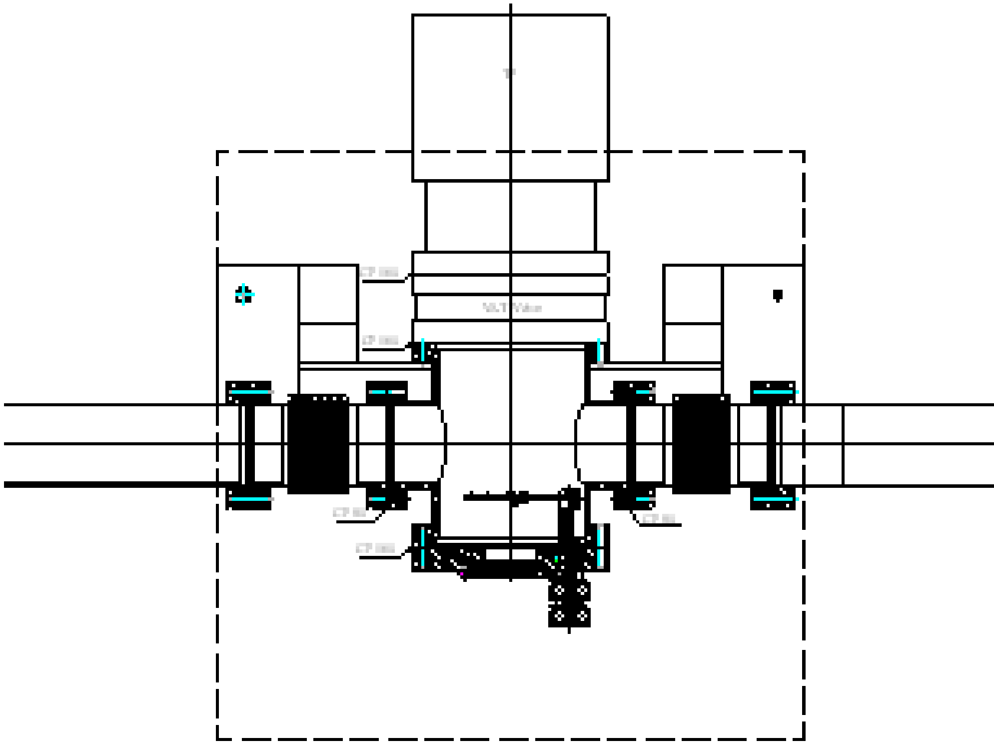
Conductance $C = Cont \cdot \frac{d^3}{l}$

(molecular flow)

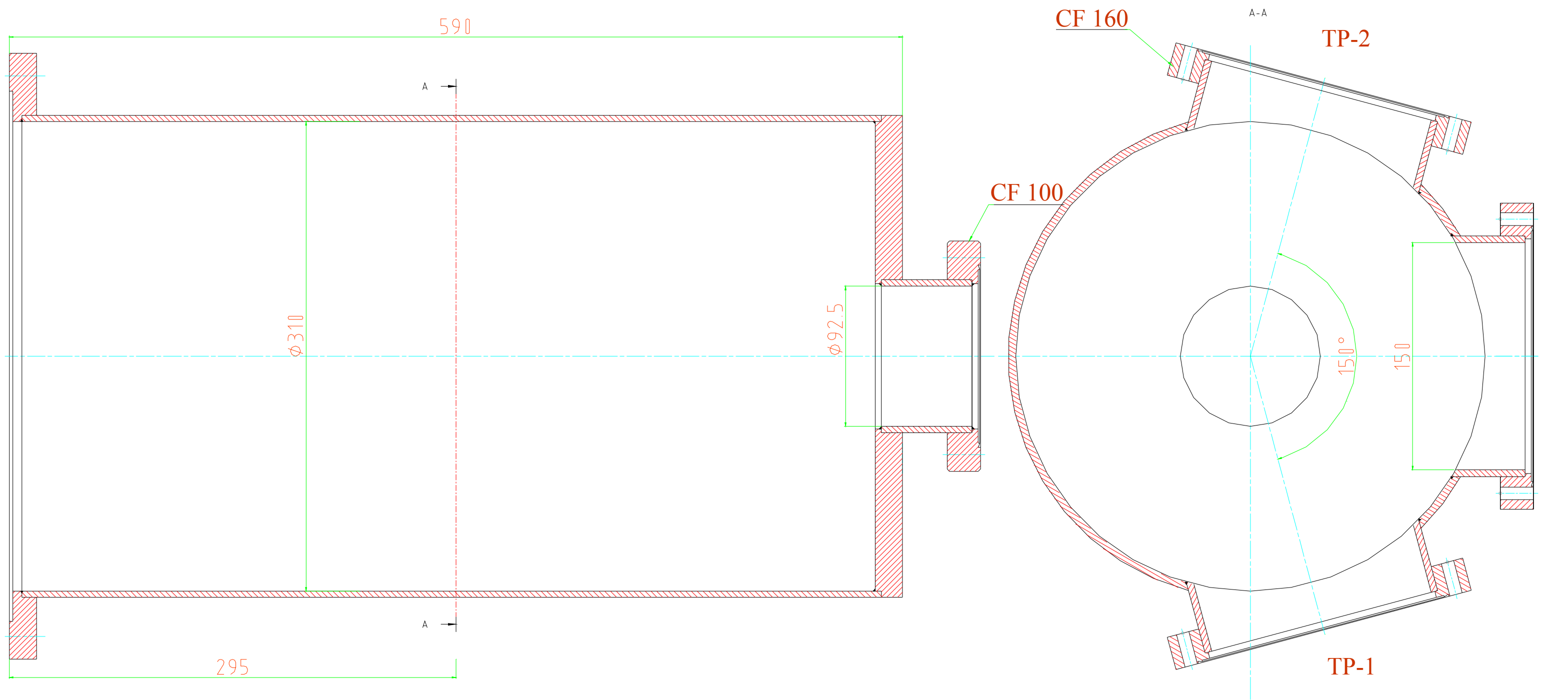
Avoid decrease of effective conductance

T with increased diameter

Connecting part of acc. tube



Critical mechanical dimensions in the vacuum system



Vacuum sealing, gaskets and feed-through

- **Problems of old vacuum system**

  BUNA-N O-rings

  Greased Wilson-sealings

  Hygroscopic plastics

- **Permeation through O-rings**

  BUNA-N is $1 \cdot 10^{-7}$ torr liter/sec/linear cm,

  VITON it is $1 \cdot 10^{-8}$ torr liter/sec/linear cm,

  Metal gasket: neglegible

Vacuum sealing, gaskets and feed-through

- **Vacuum sealing, gaskets and feed-through of new system**

  98% of old BUNA-N O-rings changed to metal gaskets

  Remaining part (2%) VITON

  Viewing glass sealed with indium

- **Feed-through**

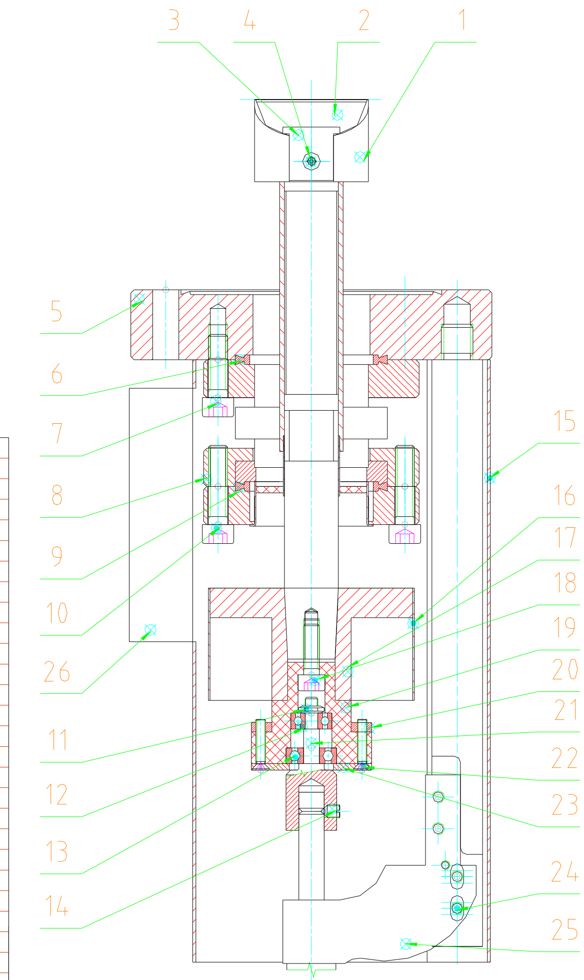
  object slits, anal. slits

  retractable direct quartz,

  magnetic coupling of viewing plates

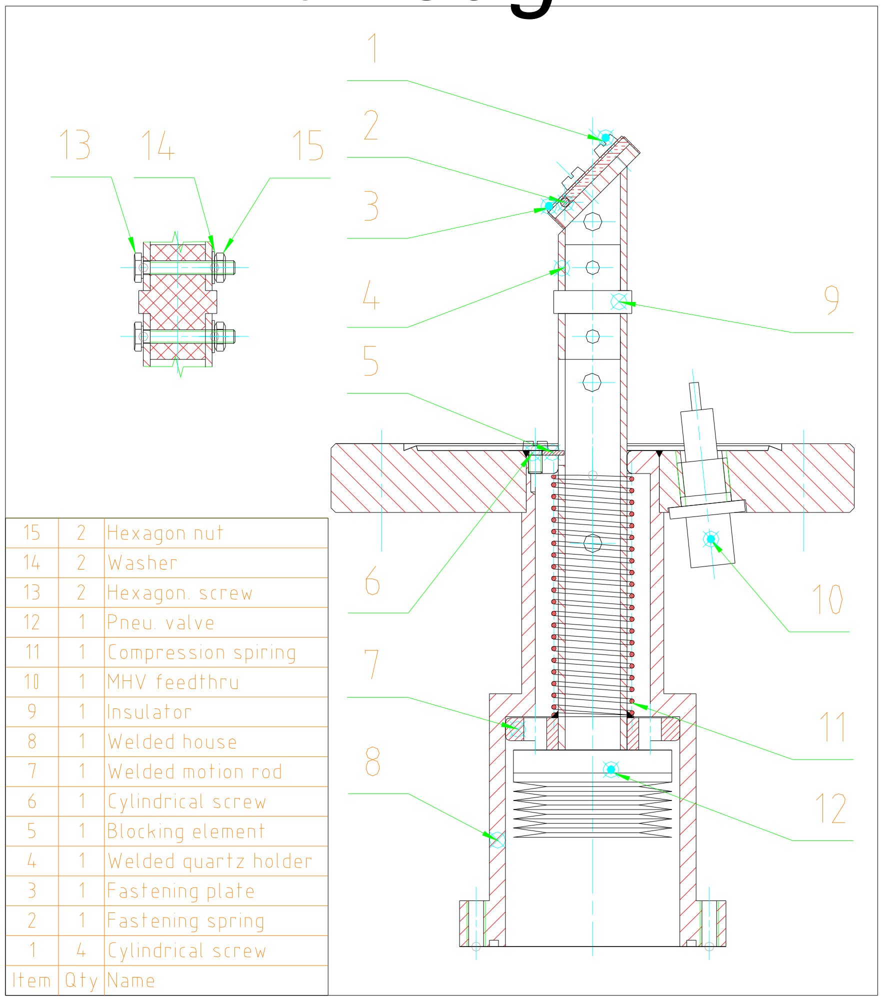
Vacuum sealing, gaskets and feed-through

Item	Qty	Name
26	1	Cooling fan
25	1	Micrometer gauge
24	2	Cylindrical srew
23	1	Cover plate
22	4	Countersunk head srew
21	1	Sleeve joint
20	1	Threaded flange
19	1	Insulated couplinge
18	1	Allen screw
17	1	Cooling fin
16	1	Baffle
15	1	Welded shield
14	2	Set screw
13	1	Deep groove ball bearing
12	1	Deep groove ball bearing
11	1	Hexagon nut
10	6	Allen screw
9	1	Metal gasket
8	1	Edge-welded bellows
7	6	Allen screw
6	1	Metal gasket
5	1	Welded flange
4	1	Posi-Drive screw
3	1	Fastening plate
2	1	Mo shield
1	1	Brazed Cu-jaw



object slits (anal. slits)

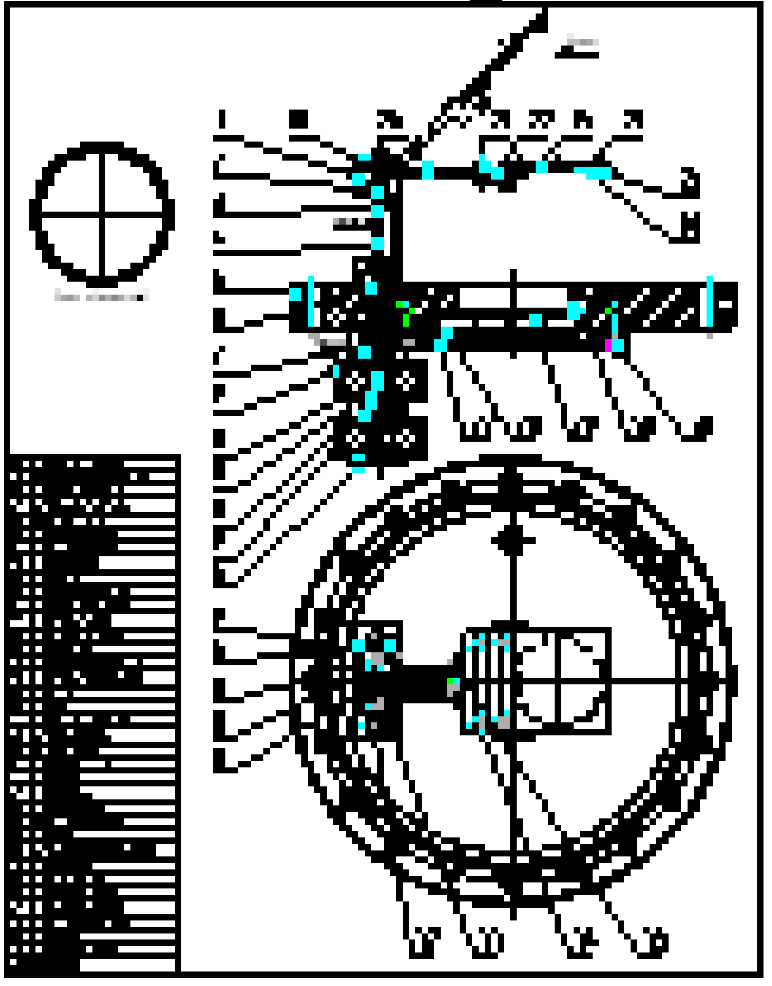
Vacuum sealing, gaskets and feed-through



Item	Qty	Name
15	2	Hexagon nut
14	2	Washer
13	2	Hexagon. screw
12	1	Pneu. valve
11	1	Compression spiring
10	1	MHV feedthru
9	1	Insulator
8	1	Welded house
7	1	Welded motion rod
6	1	Cylindrical screw
5	1	Blocking element
4	1	Welded quartz holder
3	1	Fastening plate
2	1	Fastening spring
1	4	Cylindrical screw

retractable direct quartz, (flapper valve)

Vacuum sealing, gaskets and feed-throughu



magnetic coupling of viewing plates, indium seal

Vacuum pumps, vibration caused by them

- **The vacuum stages of the beam transport and proton microprobe**

  TMU 400 MP magnetically levitated turbo molecular drag pumps,

  XtraDry 150-2 two stage piston pumps

- **Vibration dumping**

  Vibration sensitivity of proton microprobe,

  Coased by turbo pumps,

  Coming from XtraDry pumps

- **Main vacuum system**

  TMU 521 PN turbo molecular drag pumps,

  a compression ratio: $5{\cdot}10^{-6}$ for H_2.

  $5{\cdot}10^{-7}$ for He_2

  Busch Fossa 0030 three stage Scroll pumps

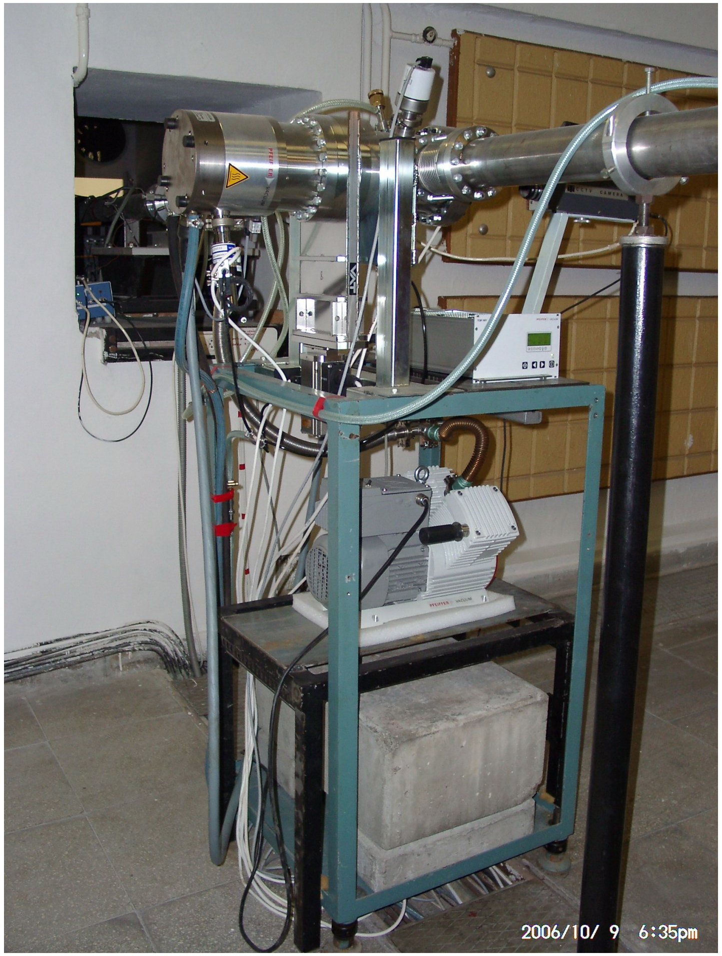
- **Saving fore pump life time**

  Common fore pump for more turbo pumps

  XtraDry pumps operated at decreased speed

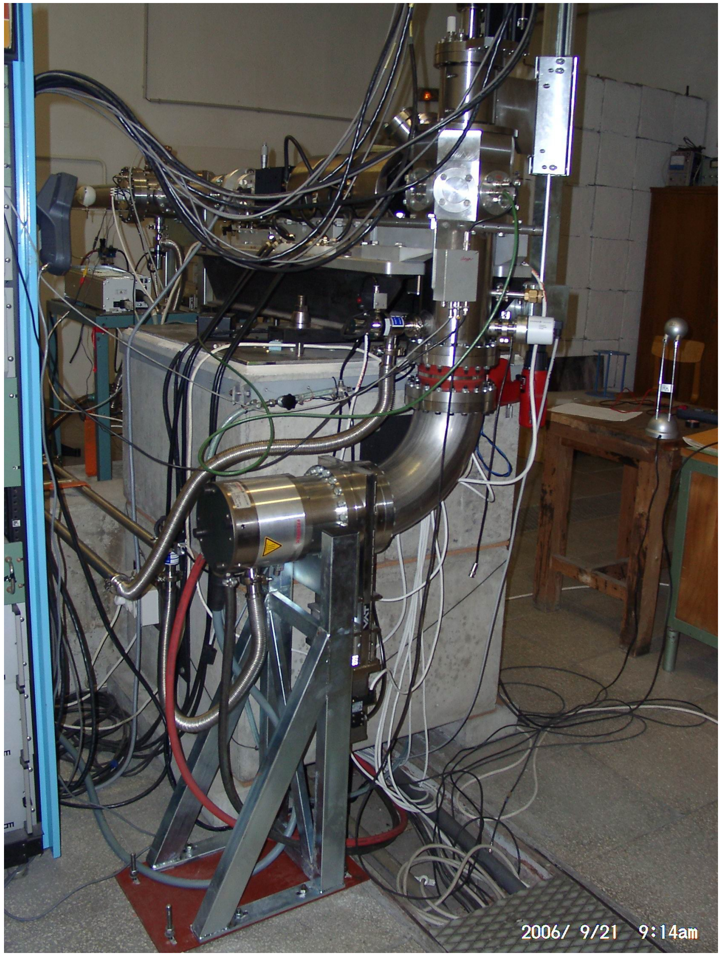
Vacuum pumps, vibration caused by them

Vacuum stage of the beam transport



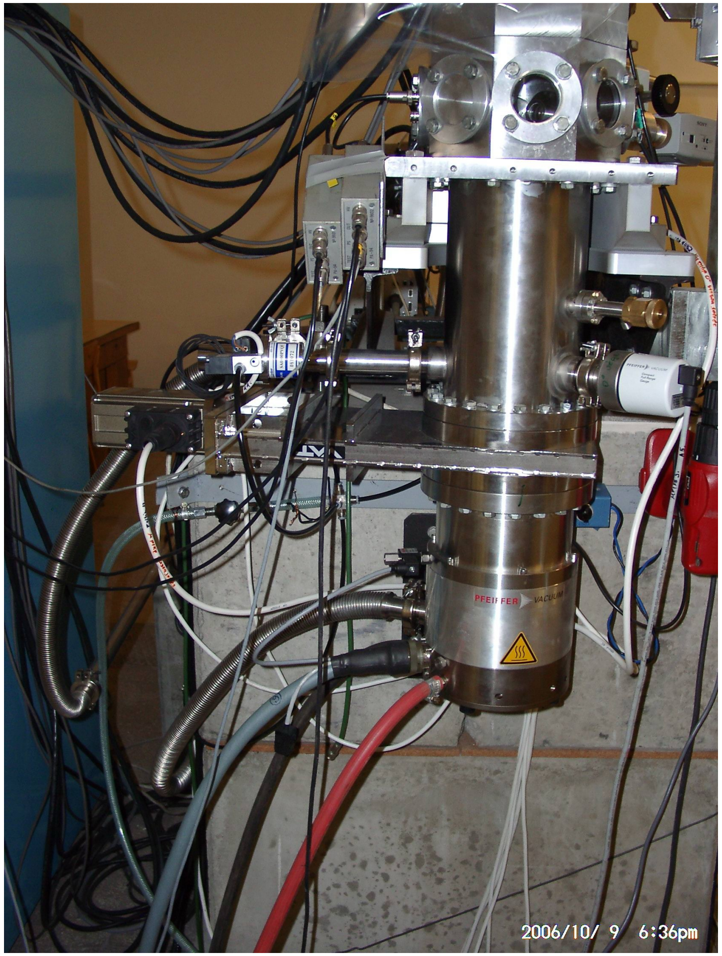
Vacuum pumps, vibration caused by them

Vacuum stage of proton microprobe, with vibration dumper



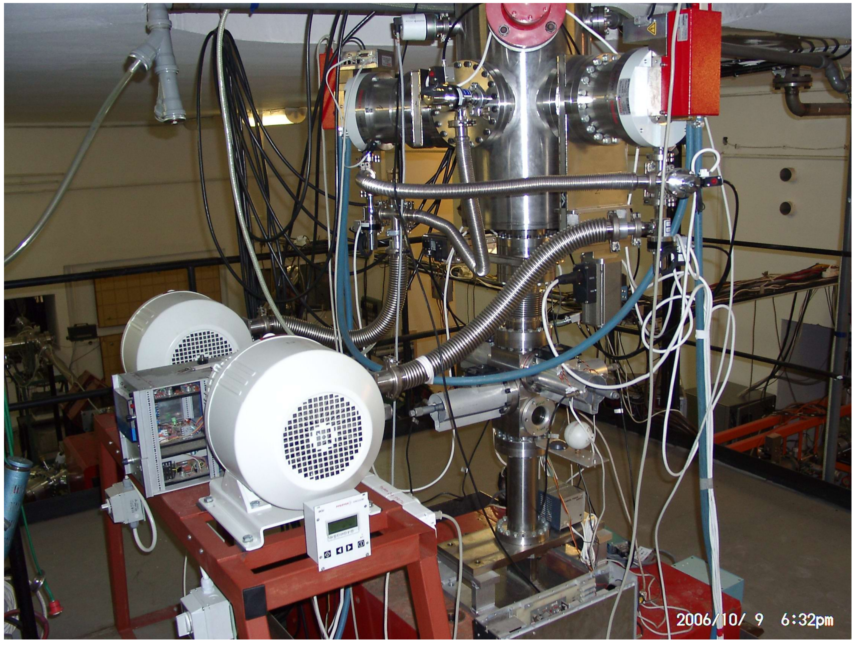
Vacuum pumps, vibration caused by them

Vacuum stage of proton microprobe, without vibration dumper



Vacuum pumps, vibration caused by them

Main vacuum system



Vacuum pumps, vibration caused by them

Common fore pump for more turbo pumps

Vacuum conductance measurements of accelerating tubes

- **the main sources of gas load**

  ion source gas (2 to 6 cm^3/h),
  the out-gassing of elastomers,
  adhesives

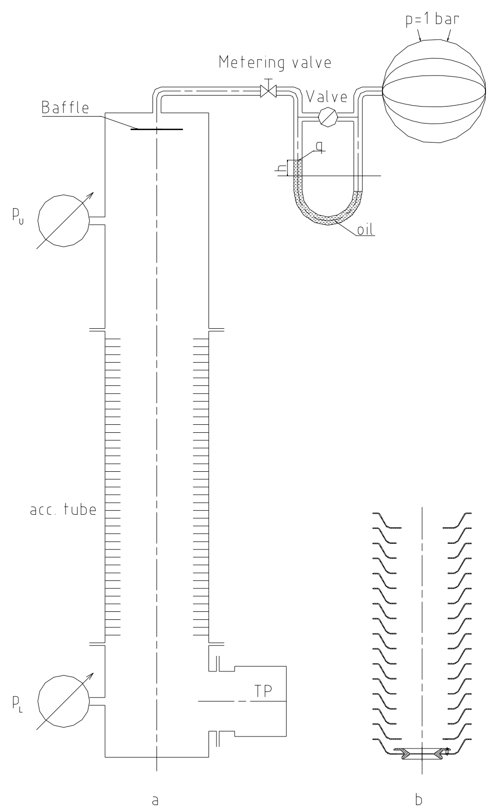
- **Measurement by others**

  based on comparison (of pressure drops across a comparison aperture and the acceleration tube to be measured, where the conductance of the aperture could be exactly calculated.)

- **Our measurement**

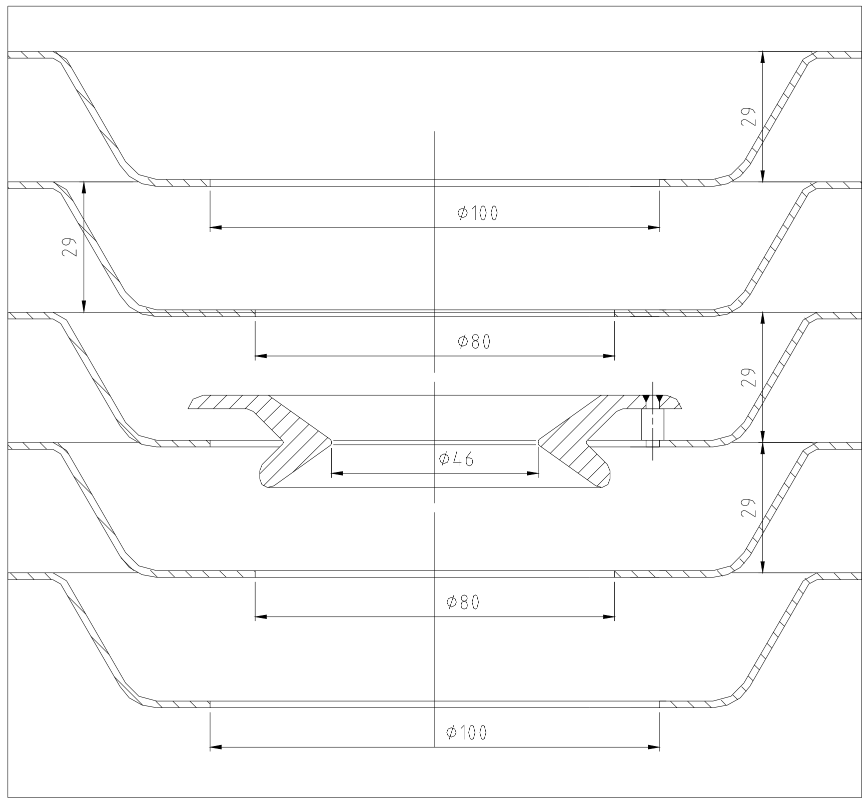
  Principle: ultimate pressure is measured at both end of acceleration tube,
  a definite throughput q_{pV} is entered by a metering inlet valve
  pressure is measured at both end at that q_{pV}
  Measuring arrangement
  Conductivity C can be calculated by the formula is given
  because of different conductivities for N_2 and H_2

Vacuum conductance measurements of accelerating tubes



Measuring arrangement

Vacuum conductance measurements of accelerating tubes



Acceleration electrode

Vacuum conductance measurements of accelerating tubes

Steps of measurement

Step	History	Met. Valve	Valve	Time
1	Met.valve disconnected from acc. tube inlet, flushed thru U-tube	open	open	1-4 h
2	Equal U-tube oil levels, 1bar at Met. Valve. Acc. tube pumped down to ultimate vacuum	closed	open	48 h
3	Desirable throughput establishes	adjusted	open	10 min
4	T_1 is logged	unchanged	close	--------
5	Significantly increased oil level and T_2 logged. Beware! Too long T, oil gets into acc. tube!!!	unchanged	closed	10-30 min
6	Process finished	closed	open	~53 h

Vacuum conductance measurements of accelerating tubes

Equations and assignment

Ultimate pressures	p_{U_0} $7.3 \cdot 10^{-6}$ $mbar$	p_{L_0} $3.8 \cdot 10^{-7}$ $mbar$				
	p_{U_N} $mbar$	p_{L_N} $mbar$	$t = t_2 - t_1$	$V = h \cdot q$	q_{pV_N}	C_N
Pressures at N_2 intake, at t_1	$3.95 \cdot 10^{-6}$	$9.3 \cdot 10^{-7}$	450 s	0.5 cm^3	$1.11 \cdot 10^{-3}$ $\frac{mbar \cdot l}{s}$	35.0 7 $\frac{l}{s}$
	p_{U_H} $mbar$	p_{L_H} $mbar$			q_{pV_H}	C_H
Pressures at H_2 intake at t_1	$6.34 \cdot 10^{-6}$	$2.22 \cdot 10^{-6}$	220 s	0.5 cm^3	$2.27 \cdot 10^{-3}$	41.5 7 $\frac{l}{s}$

$$C_N = \frac{q_{pV_N}}{\left(p_{U_N} - p_{U_0}\right) - \left(p_{L_N} - p_{L_0}\right)} \qquad C_H = \frac{q_{pV_H}}{\left(p_{U_H} - p_{U_0}\right) - \left(p_{L_H} - p_{L_0}\right)}$$

Conclusions

The project has been successfully completed. Vacuum levels are in good agreement with the expectation. The conductance of the acceleration tube for H2 is acceptable. Certain parts of the vacuum system have not been baked yet. Baking probably further improves vacuum

References

- [1] B. J. J. Slagmolen, T. Slade, C. Mow-Lowry, AIGO Vacuum Part Cleaning Process, ACIGA internal report, Version 1.2, 5 February 2004.
- [2] Phil Danielson, A Journal of Practical and Useful Vacuum Technology, www.vacuumlab.com
- [3] H.R.McK. Hyder. Vacuum conductance measurements of accelerating tubes Nuclear Physics Laboratory Report Ref.37/72, Oxford University

VACUUM TECHNOLOGY TALK

Kevin Armstrong
AVT Services Pty Ltd.
Seven Hills, NSW, Australia

(No abstract for this talk)

Questions:

Roland Syzmanski (University of Melbourne): Do you have practical experience in an accelerator environment because it is a fairly harsh environment. Most people here are operating accelerators and you can have tank sparks.

Armstrong: It is dependent on the gaugehead you put in.

Syzmanski: I was wondering about the controller itself.

John McKay (retired): I have seen a lot of electronics go up in smoke and it is just due to the induced voltage from sparks. A controller doesn't even have to be plugged in to see damage.

Fred Johnson (ANU): I wanted to ask you a question about the ion pump. What is the pumping speed and what sort of pressure is it good to?

unintelligible .... :

New Technology in Vacuum Gauging

The TIC Instrument Controller

New 6-head models

Dr Adil Adamjee

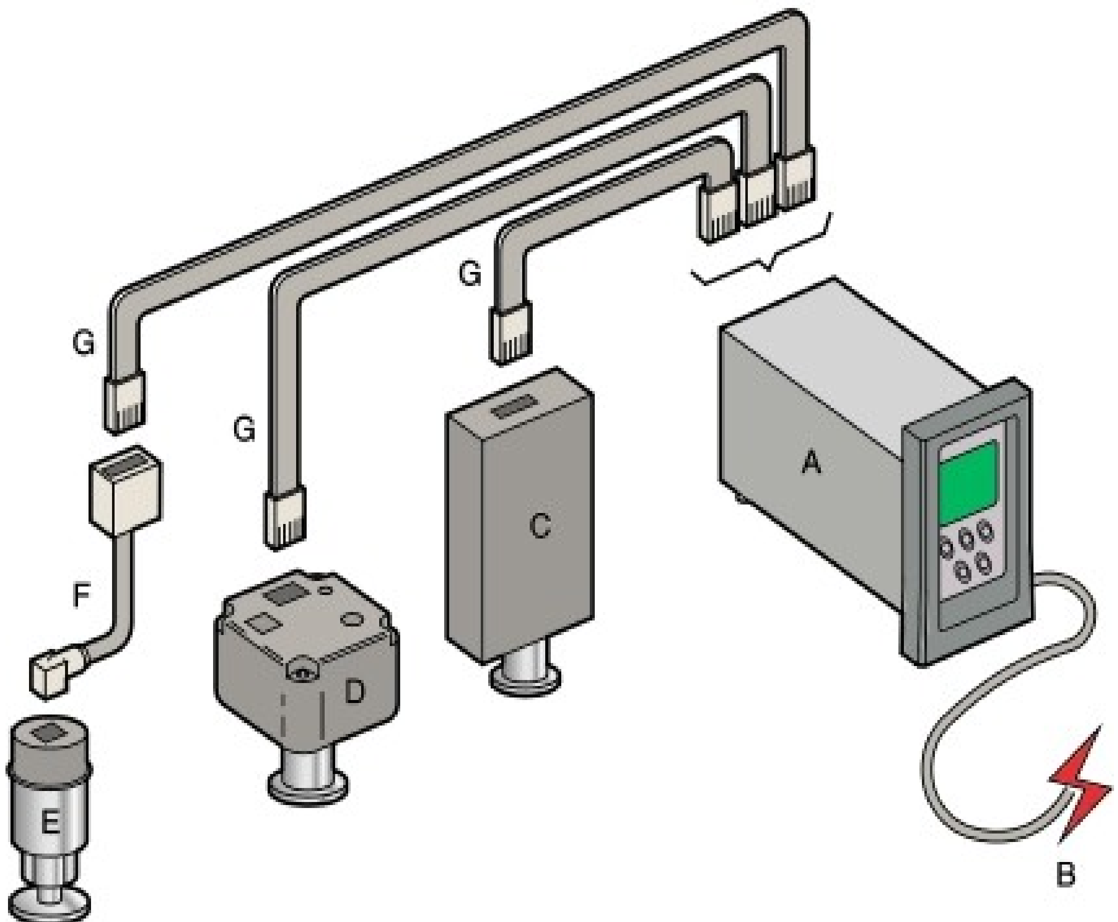
AVT Services Pty Ltd

Why do we need new products?

- Current range of TIC Instrument Controllers can only accept a maximum of three gauge inputs, none of which can be a capacitance manometer

- Many vacuum measurement and control systems have four or more gauge heads fitted

- New products will simplify our product range and allow us to make AGC 6H products obsolete

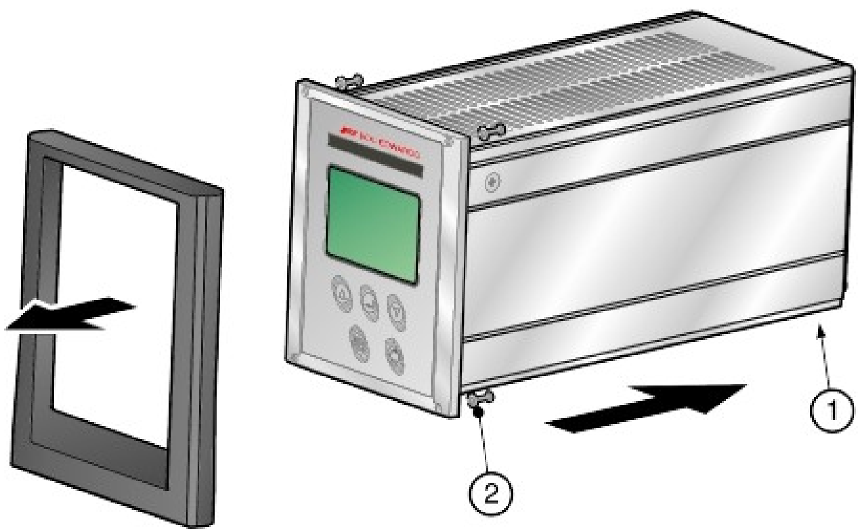


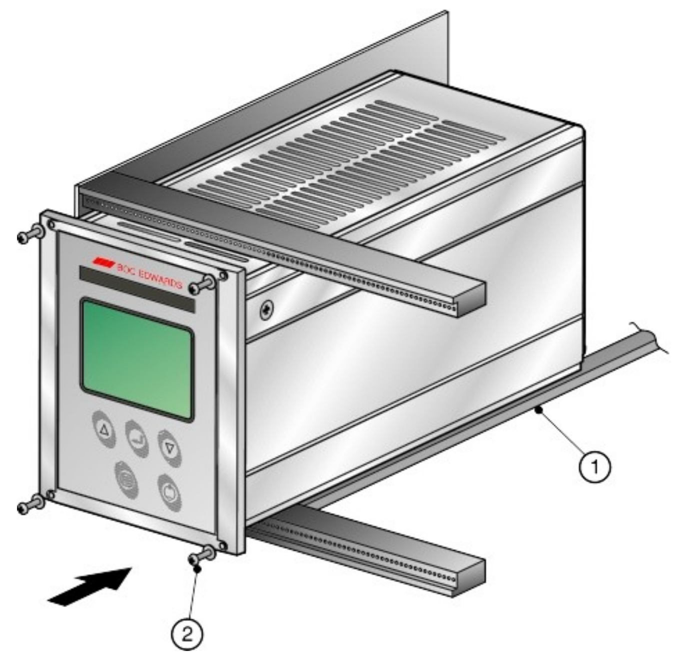
New TIC Instrument controllers

Same choice of mounting options…

- Bench top… …or Panel mounted

(¼ 19” sub rack 3U high x 245mm deep)





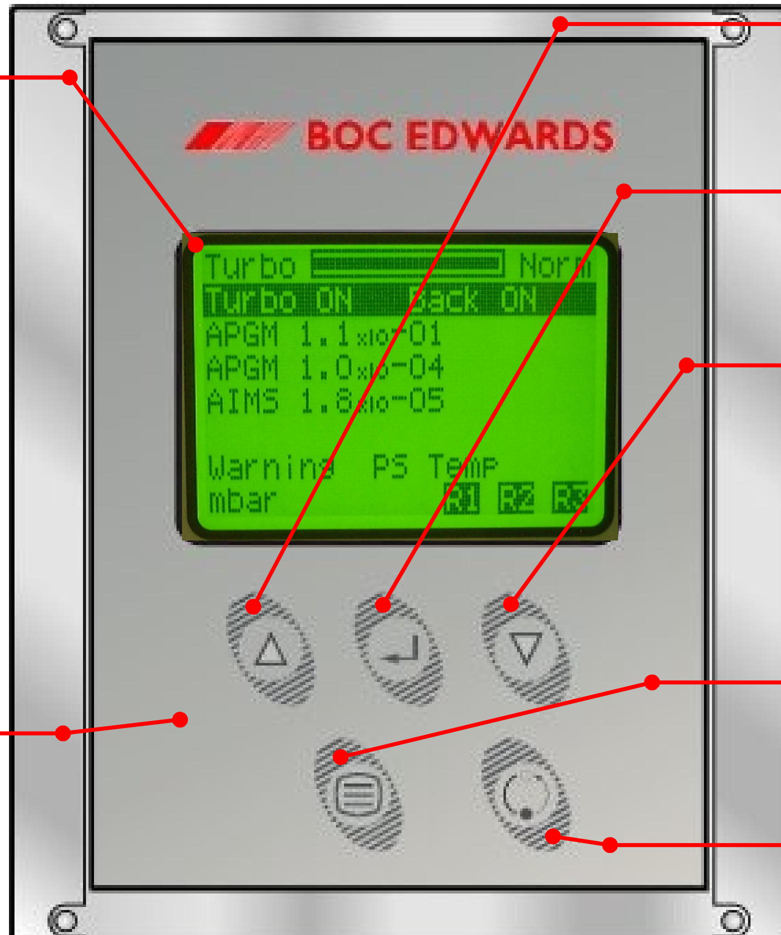
AVT Services Pty Limited
ACN 056 503 461
Vacuum & Cryogenics

Same clear graphics and controls

Graphical LCD
Shows:-
- Speed & acc'n
- Pump status
- 3 gauge outputs
- Alarms
- Pressure units
- Relay status

Display adapts to TIC type

Tactile keypad



'Scroll up' button

'Select/Hotkey' button

'Scroll down' button

'Menu/Back' button

'Cycle' button

✵ ***Common to all versions***

Same intuitive interface

- View system status
- Mobile phone type menu structure
- Set up gauges
- Set up pumps
- View & create links
- Set link parameters

AVT Services Pty Limited
ACN 056 503 461
Vacuum & Cryogenics

New six-head Instrument Controllers

Two new Controllers are announced:

TIC Instrument Controller 6-head D39701000

- Up to six Active gauges including:
- BOC E Ion Gauge Controller (IGC)
- Up to three Active Ion Gauge (AIGX)

New six-head Instrument Controllers

TIC Instrument Controller 6-head *Capman* D39702000

- Up to six Active gauges including:
- BOC E Ion Gauge Controller (IGC)
- Up to three Active Ion Gauge (AIGX)

  Or

- Up to three Barocel Capacitance Manometers
  - From 600, 622. 655, 658 series – N.B. the mix is limited to 15 w of power (More on this later…)

Common Features of Both Controllers

Six relay set-points

- With variable hysteresis
- Triggered by pressure or voltage
- Can be assigned to any gauge
- May be manually overridden through the key-pad
- Relay status displayed on screen

Common Features of Both Controllers

Analogue outputs

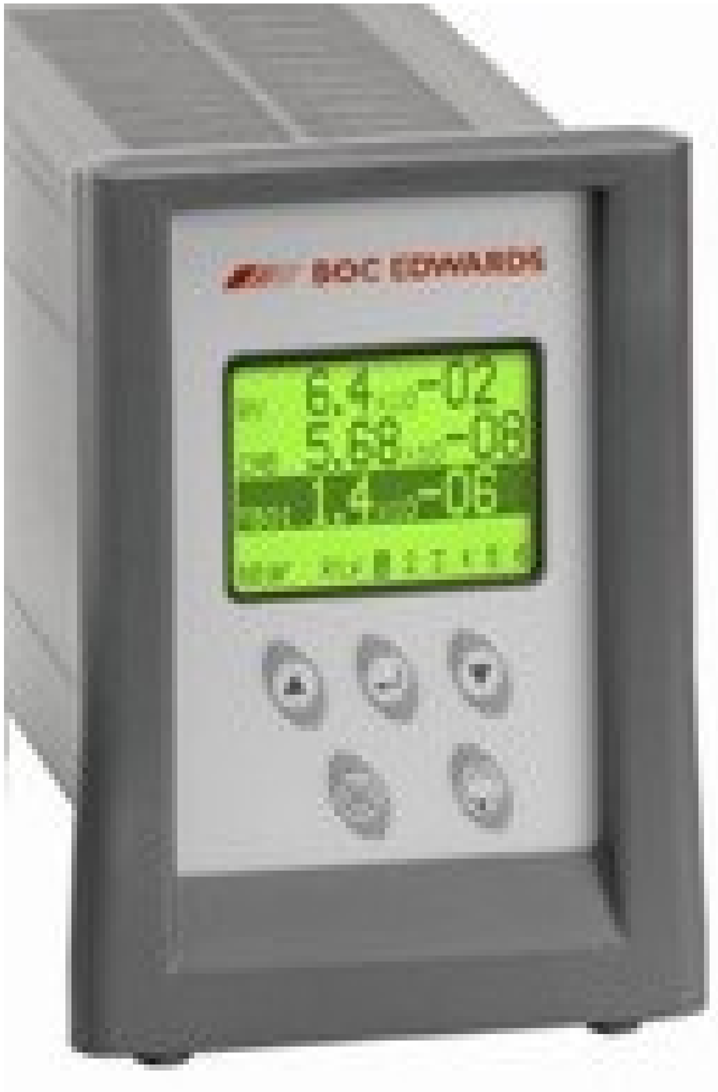
- Six 0-10 V buffered analogue outputs - one per gauge for chart recorder or similar

Display options

- Display options:

a) Show all six gauges

Display options



b) Show any three gauges

- scroll through all connected gauges with the choice of order

Display options

c) Show one gauge at at time

- scroll through all connected gauges with the choice of order

Display options

Gauge "naming"

When connected, each gauge type is identified e.g APGL

But to make things clearer, each gauge can be given a four character alphanumeric name.
E.G.

RV1

LL2

CHMB

TIC Instrument controller - six head

Compatible Active gauges:

Up to six active gauges may be connected from:

- APG   M & L
- APGX M & L
- APGX-H
- AIM
- WRG
- ATC
- ASG
- IGC
- AIGX - (up to three with only one in degas at any one time)

TIC Instrument controller - six head Capman

Compatible Active gauges:

The same choice of Active gauges *and* up to three Barocel capacitance manometers

Compatible Barocel manometers:

- 600
- 622
- 655
- 658

Note the 659 series are NOT supported

TIC Instrument controller - six head Capman

The number of Barocel Capacitance manometers is determined by the power available
– MAX POWER IS LIMITED TO 15 W

Model	Power
Barocel 600, 622	1 W
Barocel 655	7.5 W
Barocel 658	15 W
Barocel 659	Not supported

Protection for Capacitance Manometers

Our Barocel capacitance manometers require 15 V DC, while the power supplied by the TIC Instrument controller for other Active gauges is 24 V DC.

Barocels may only be plugged into the lower three sockets on the back panel of the TIC Instrument controller.

If a Barocel is plugged into one of the upper sockets, a warning is given, the gauge will not work, but no harm will come to the Barocel.

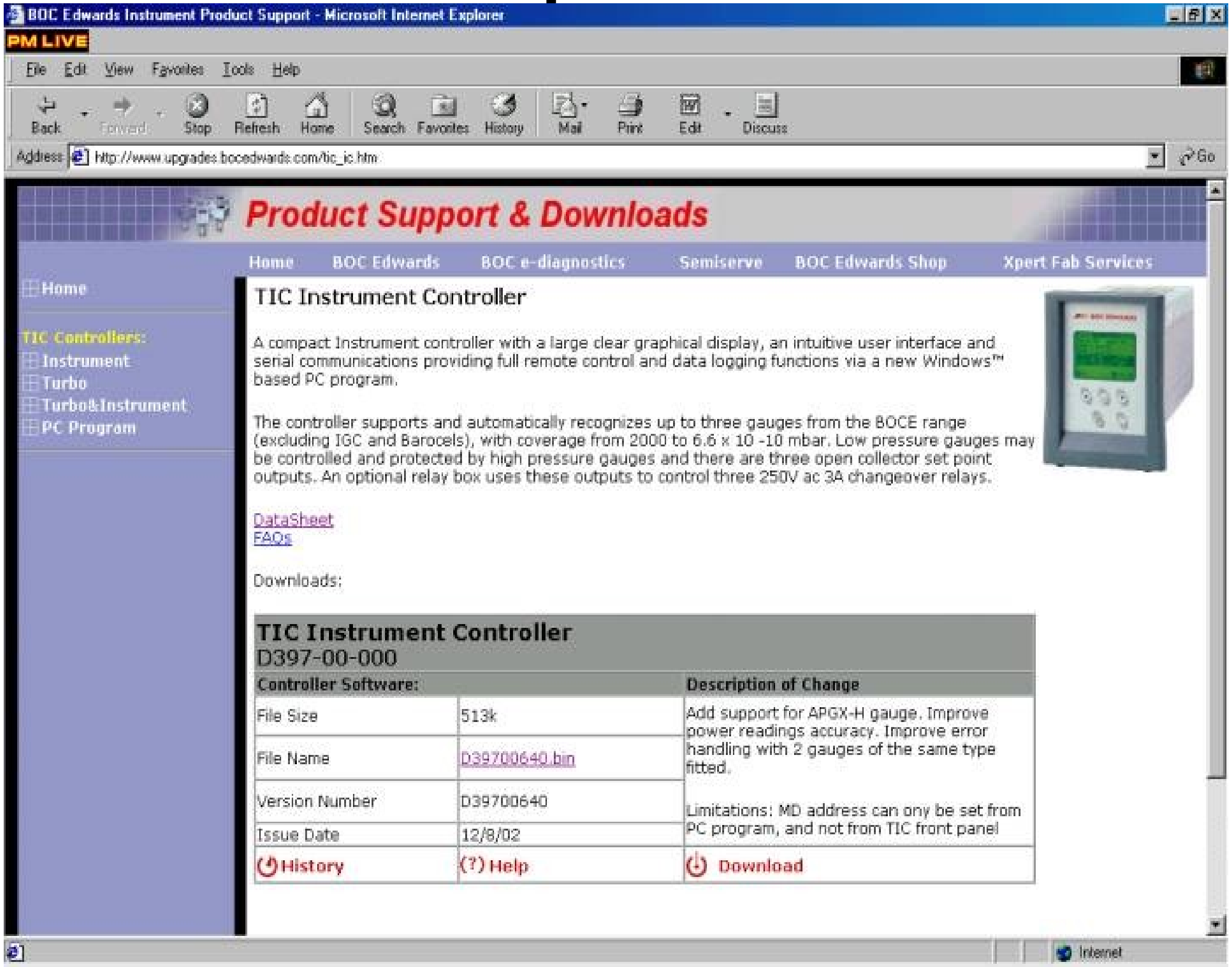
The same protection is provided on the TIC Instrument controller six head. Should a Barocel inadvertently be plugged into any of the six gauge sockets, a warning is given, the gauge will not work, but no harm is done to the Barocel.

N.B. There is no Barocel protection on any of the three head TIC Instrument controllers or TIC Turbo and Instrument controller. These have never be compatible with Barocel capacitance manometers – should a Barocel be plugged in, damage to the gauge may occur.

PC Programme

The PC programme has been updated to include the new six head capability

Software updates



www.upgrades.bocedwards.com

AVT Services Pty Limited
ACN 056 503 461
Vacuum & Cryogenics

Part Numbers

TIC Instrument controller - six head	**D397-01-000**
TIC Instrument Controller - six head Capman	**D397-02-000**

And now for a practical demonstration….please see us at the AVT Services stand

General Discussion: (audio quality poor in this session)

Steve Ferguson (Western Michigan): A few years ago I was talking to an industrial lab and they were replacing their diffusion pumps with turbo pumps because their companies were monitoring the electrical going into their lab. I was wondering if people had had experience with energy savings with different kinds of pumps.

(no responses)

????: Question concerning variable speed pumps

Marha Meigs (Oak Ridge National Laboratory): Some of you will remember Dale Hemsley's system of backing several turbopumps with one scroll pump. It just comes on when the backing pressure gets high enough to need it. We did the same thing for backing. It is automatically controlled with a gauge and a relay.