AMS02 TIM and General Meeting

Th. Kirn
I. Phys. Institute RWTH Aachen

March, 7th 2001

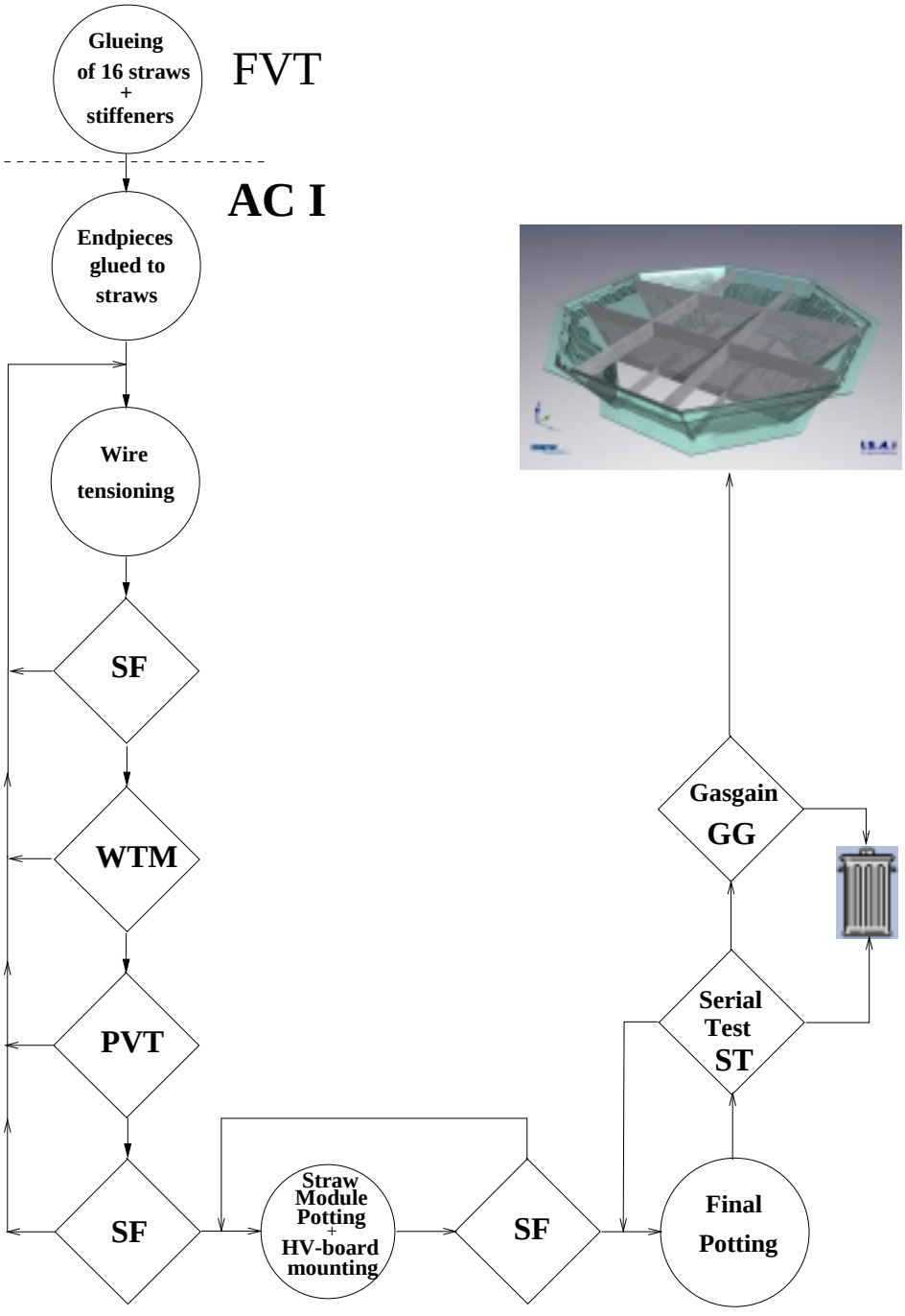
- Straw-Module Production
- Radiators

RWTH Physics AC-I

Straw Module Production

Th. Kirn
Th. Siedenburg

Straw Module Production



Production Process

FVT:

- glueing of 16 straws and stiffeners
  (cleanroom, 2 modules per day)

AC I:

- endpieces glued to straws (cleanroom)

- wire tensioning and crimping (cleanroom)
  - **SF**: signal feedthrough
  - **WTM**: wire tension measurement (eigenfrequency)
  - **PVT**: preview test (noise spectrum (HV, Ar/CO_2))

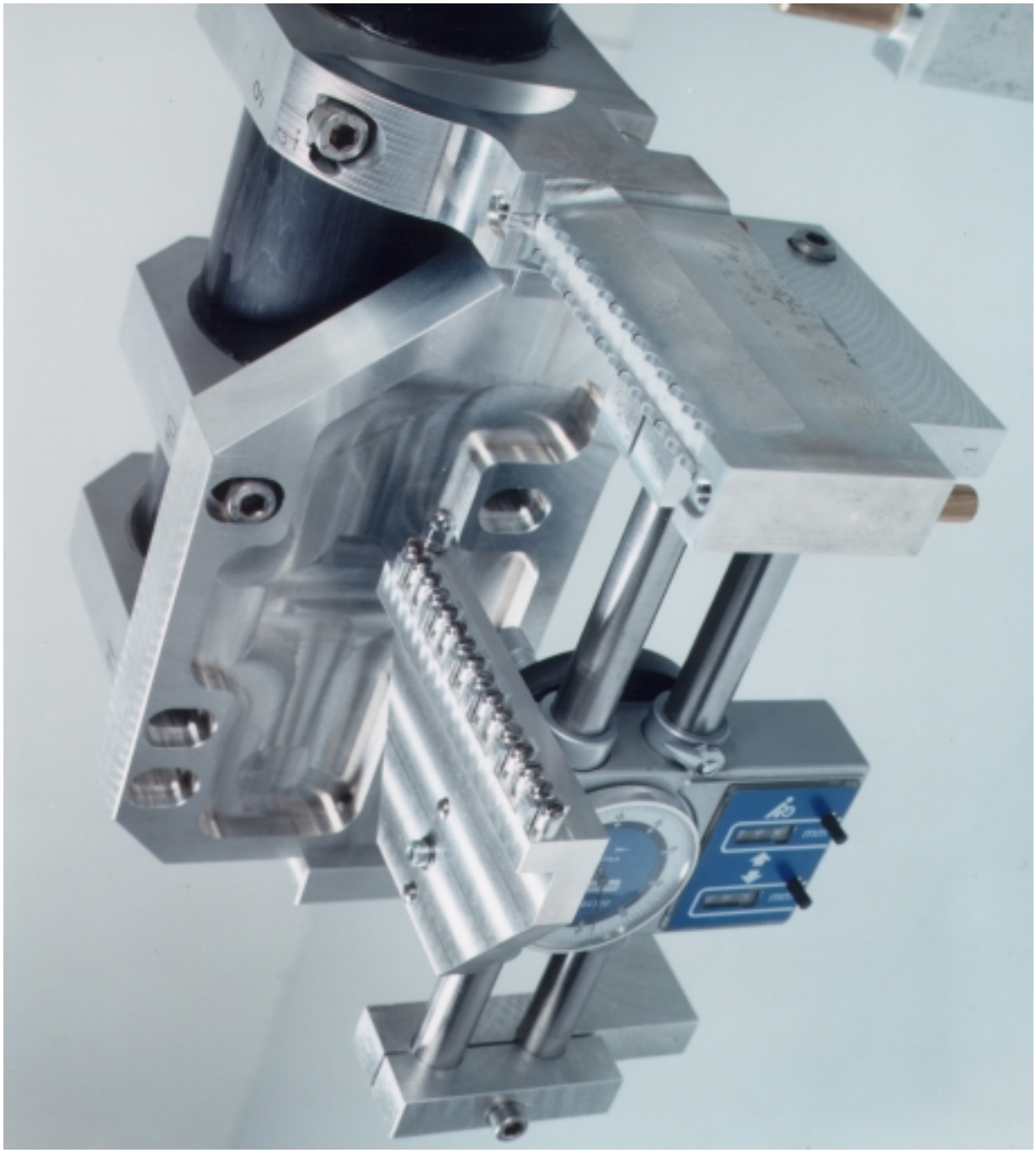
- straw module potting, HV-board mounting
  - **SF**

- final potting

- operational tests
  - **ST**: serial-test, gas-tightness, dark current, corona
  - **GG**: gasgain, G(HV) (Xe/CO_2, Fe^{55} TMS)
  + subsample: X-ray wire position
  + long term test: gasgain(flow, density, mixture)
    [in closed circuit]

FVT

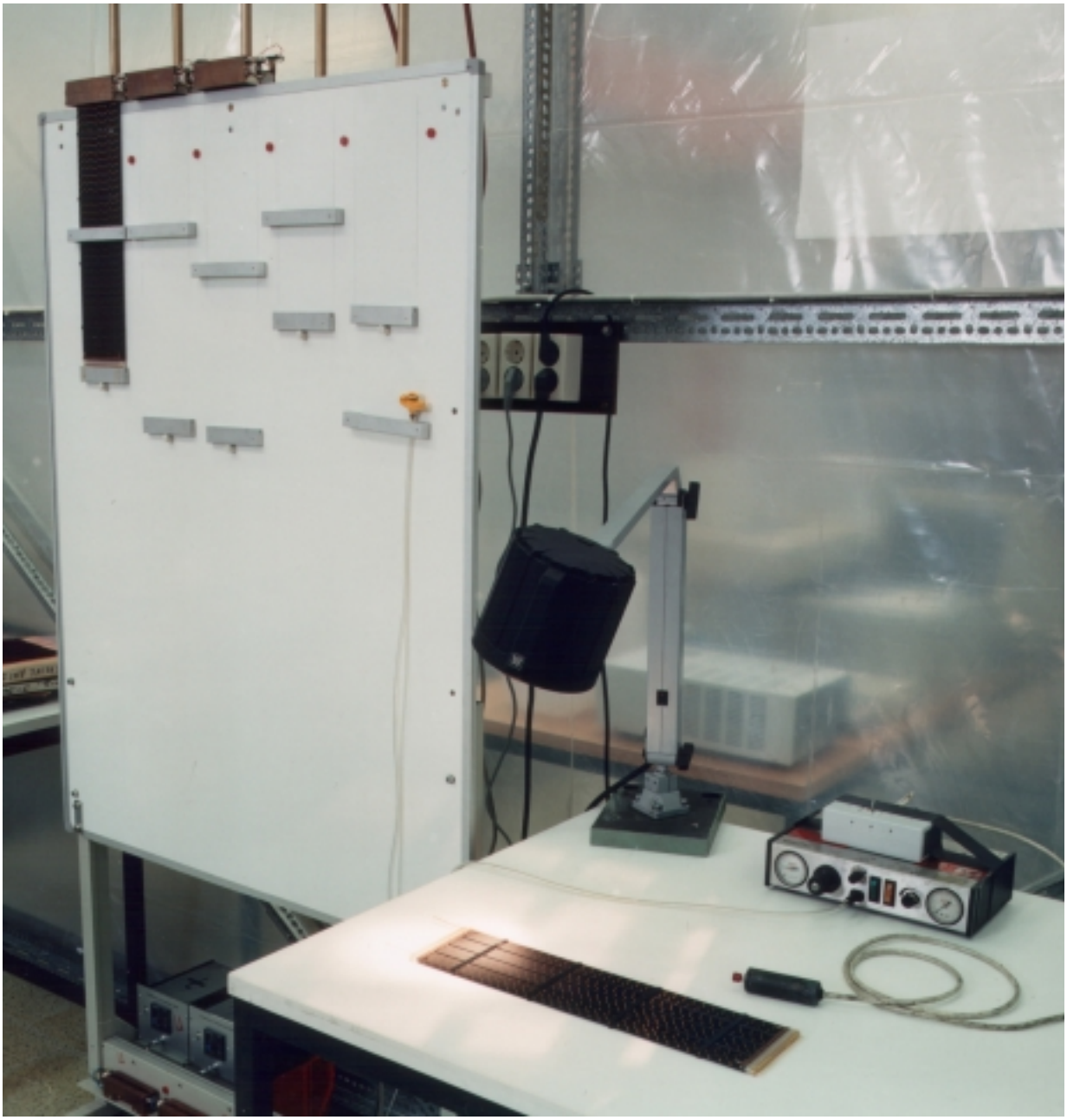
FVT



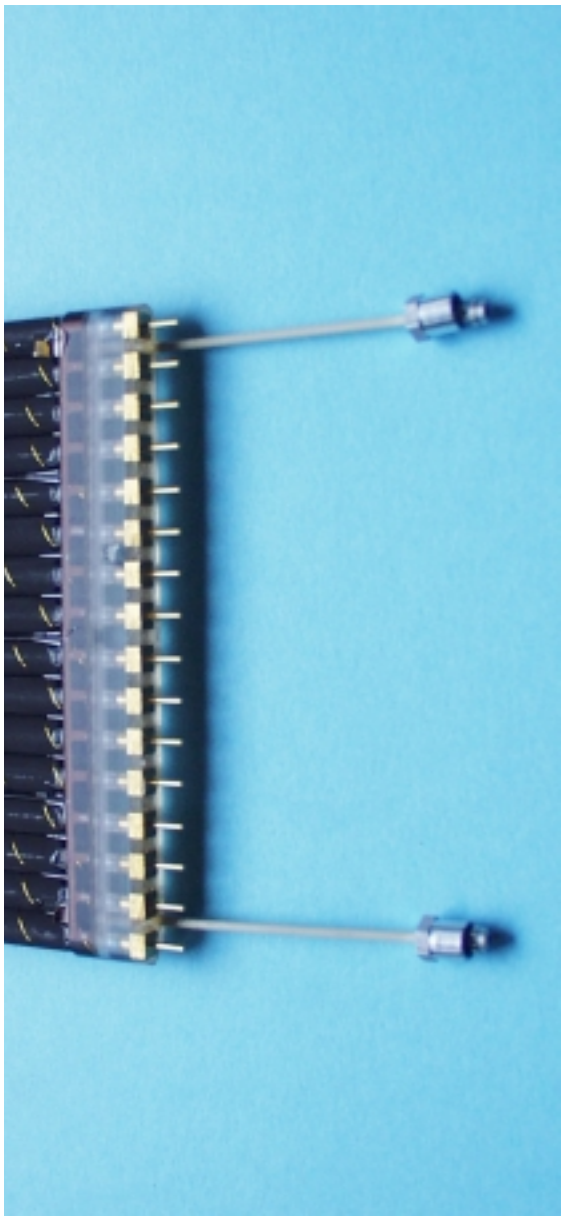
FVT

FVT

AC I

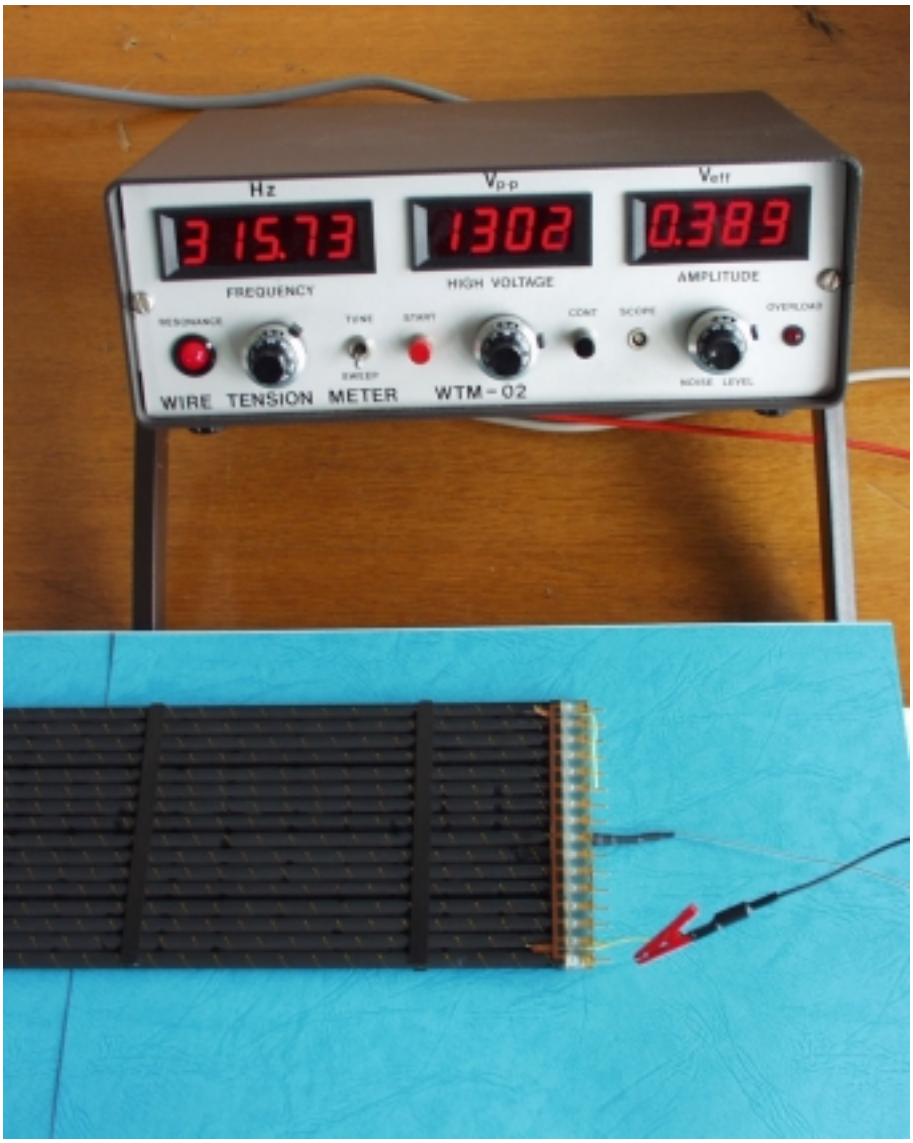


AC I



WTM: Wire Tension Measurement

$$m = \frac{4L^2 f^2 \rho_l}{g}$$

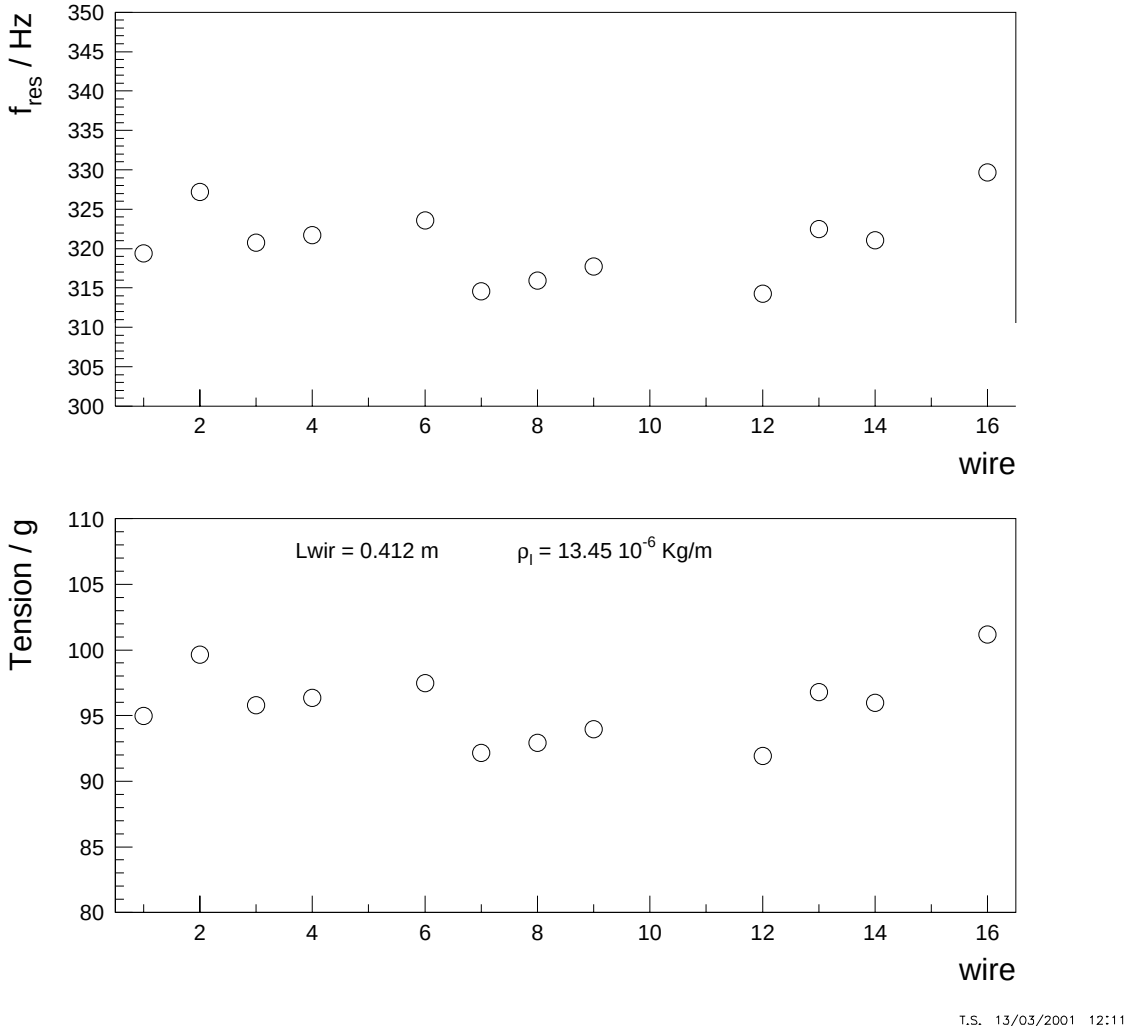


Quality Control:

Wire Tension: (100 ± 10) g

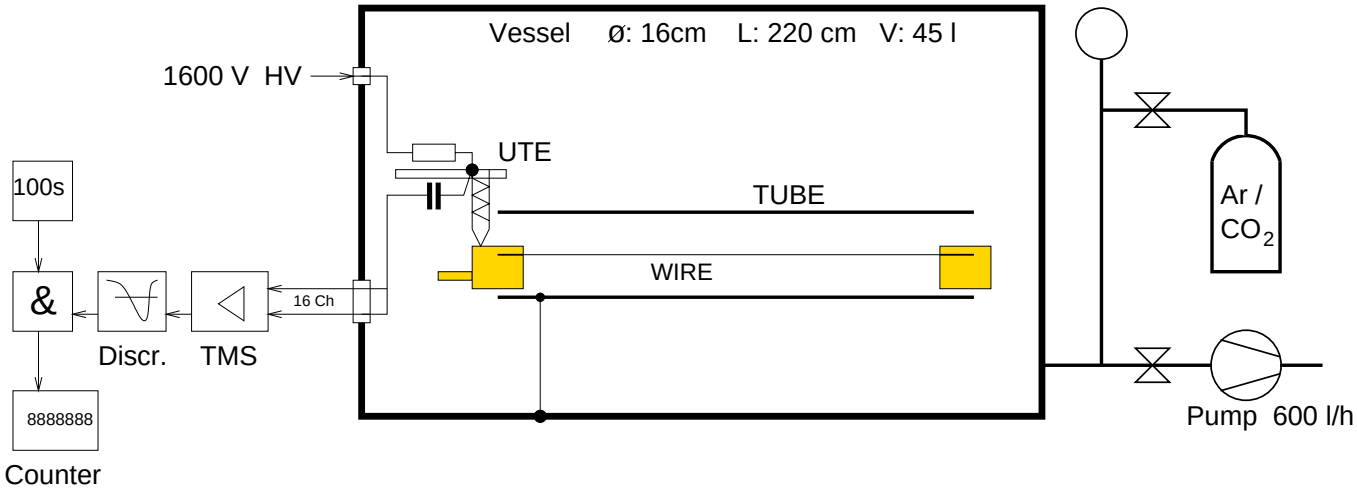
WTM: Wire Tension Measurement

Chamber 5



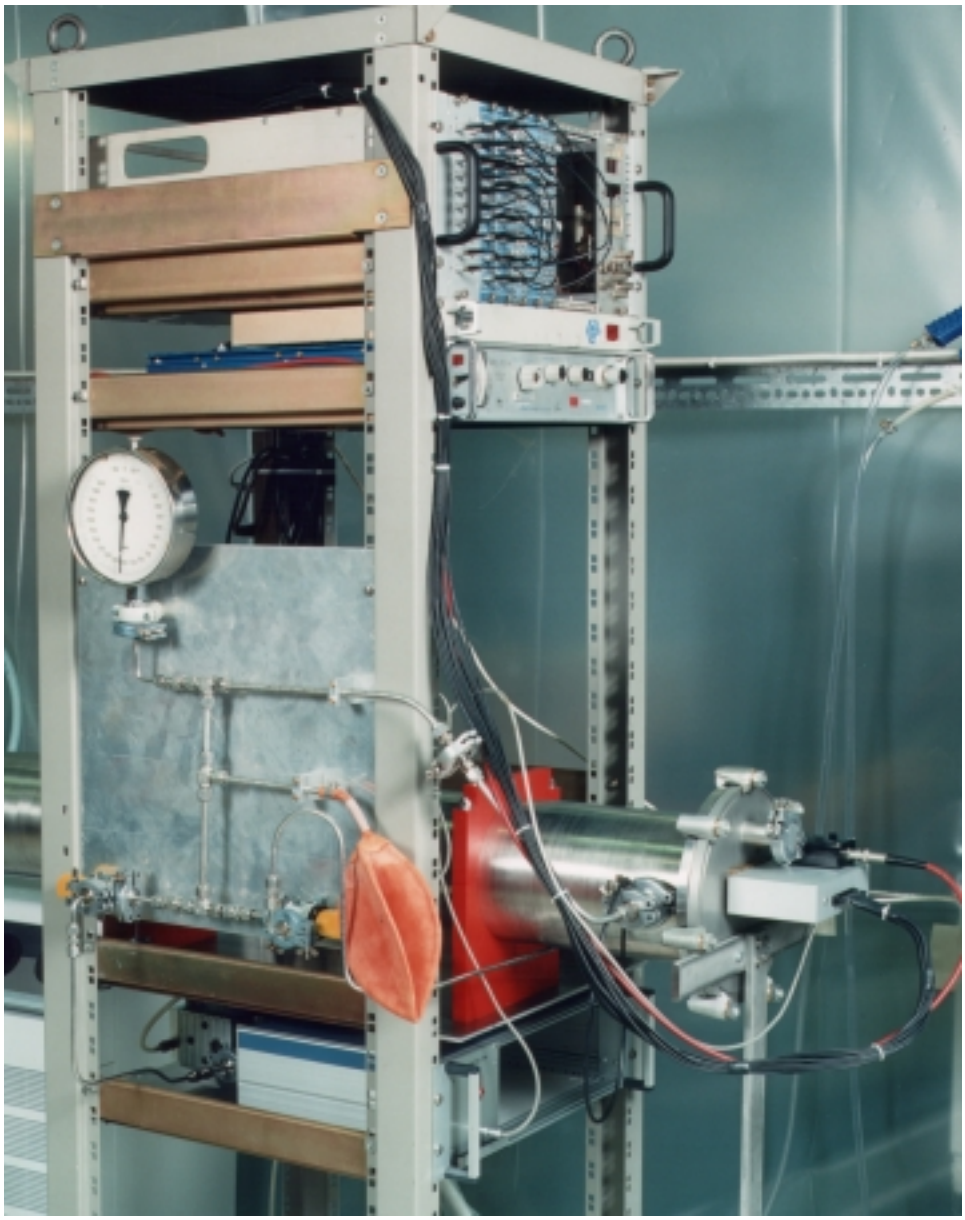
PVT: Preview Test

Measurement of counts above threshold (HV, Ar/CO_2)

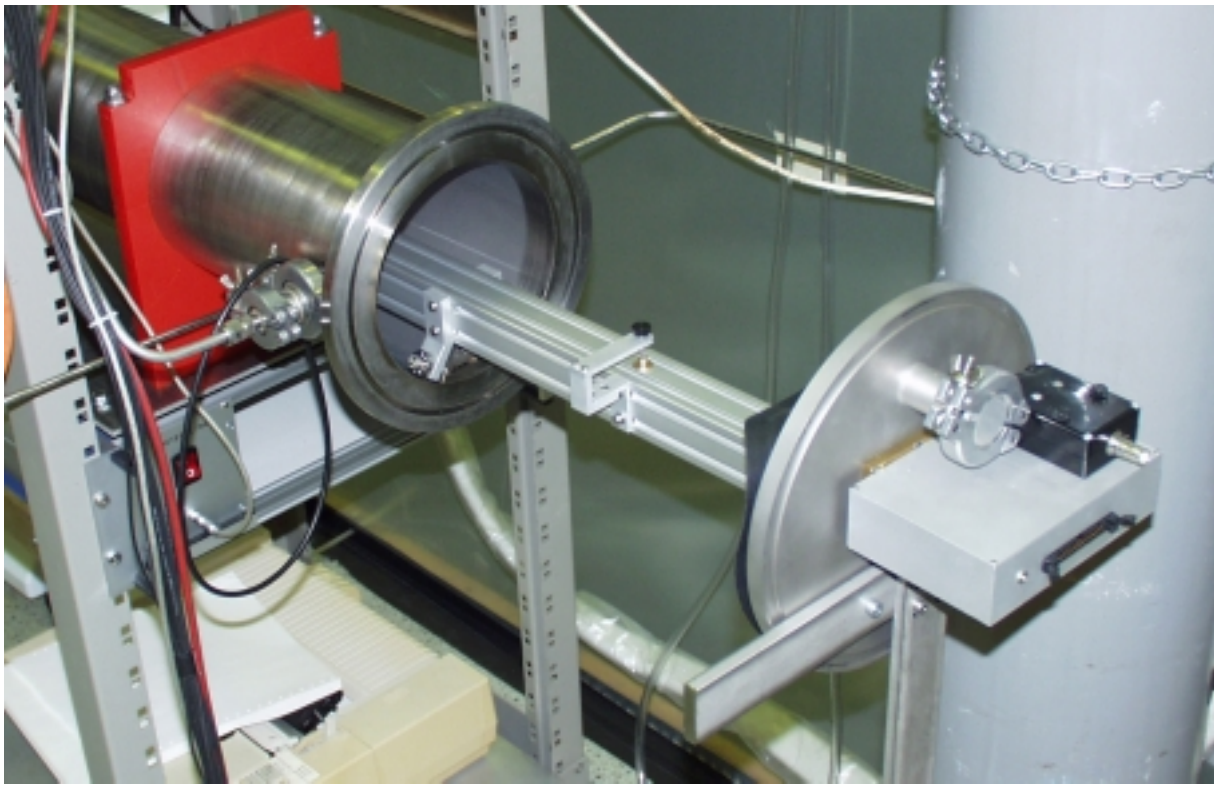


Quality Control: has to be decided

PVT: Preview Test



PVT: Preview Test



ST: Serial Test

6 Straw Modules parallel

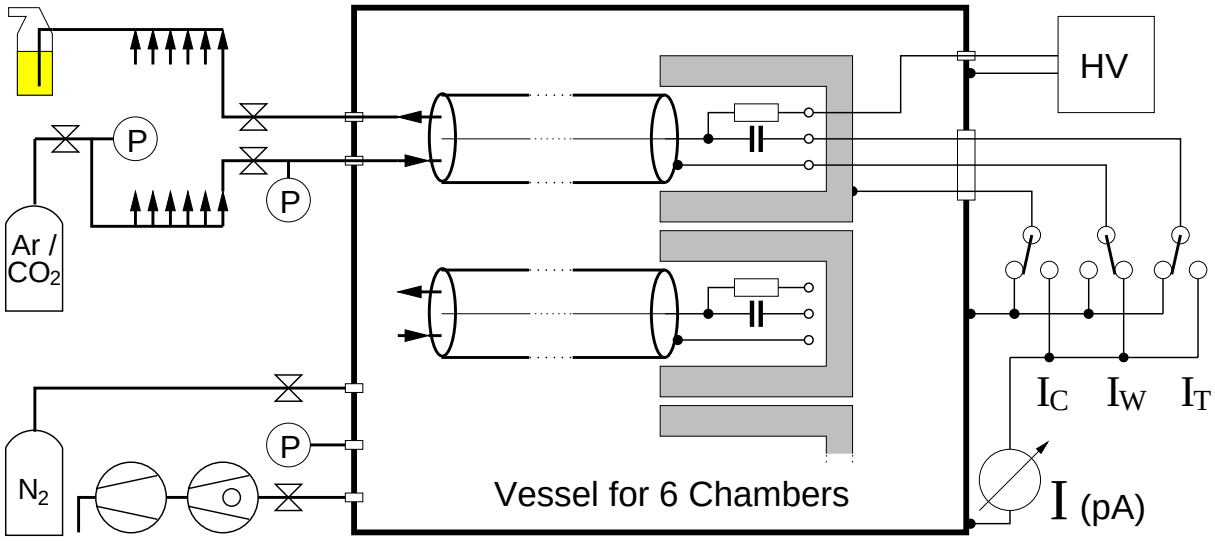
Measurement of gas tightness, dark currents, corona

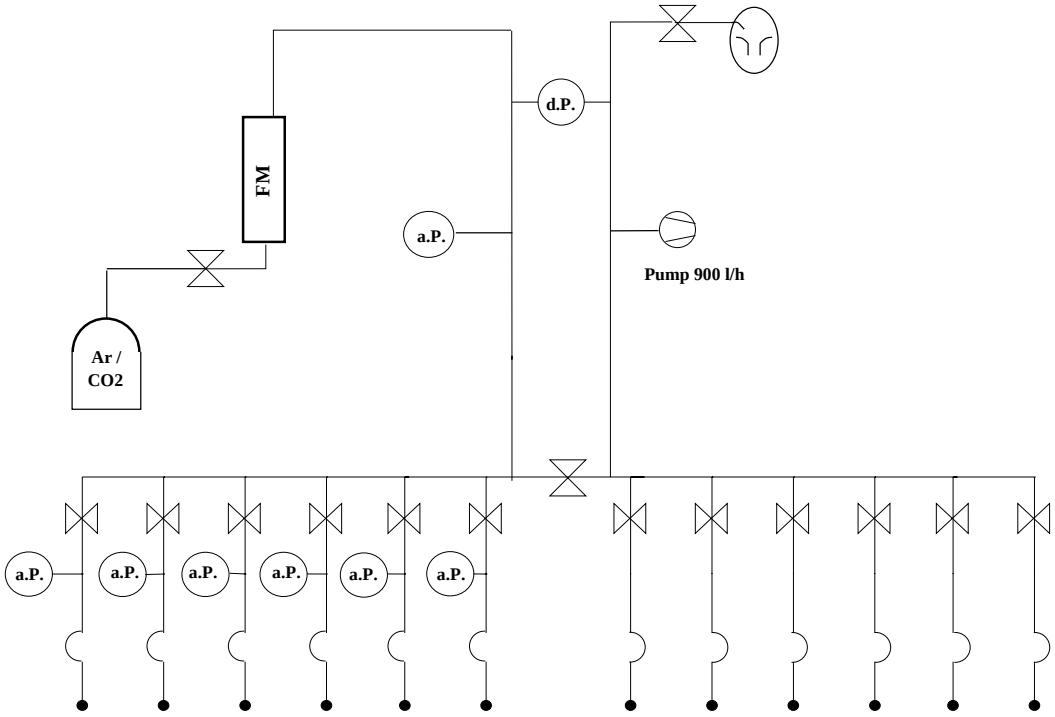
- over pressure burst test: p=2.5 bar

- gas tightness: $\frac{\Delta p}{\Delta t} \leq 10^{-4} \frac{\mathrm{mbar}}{\mathrm{s}}$
  (p=2.0 bar, t=100 h)

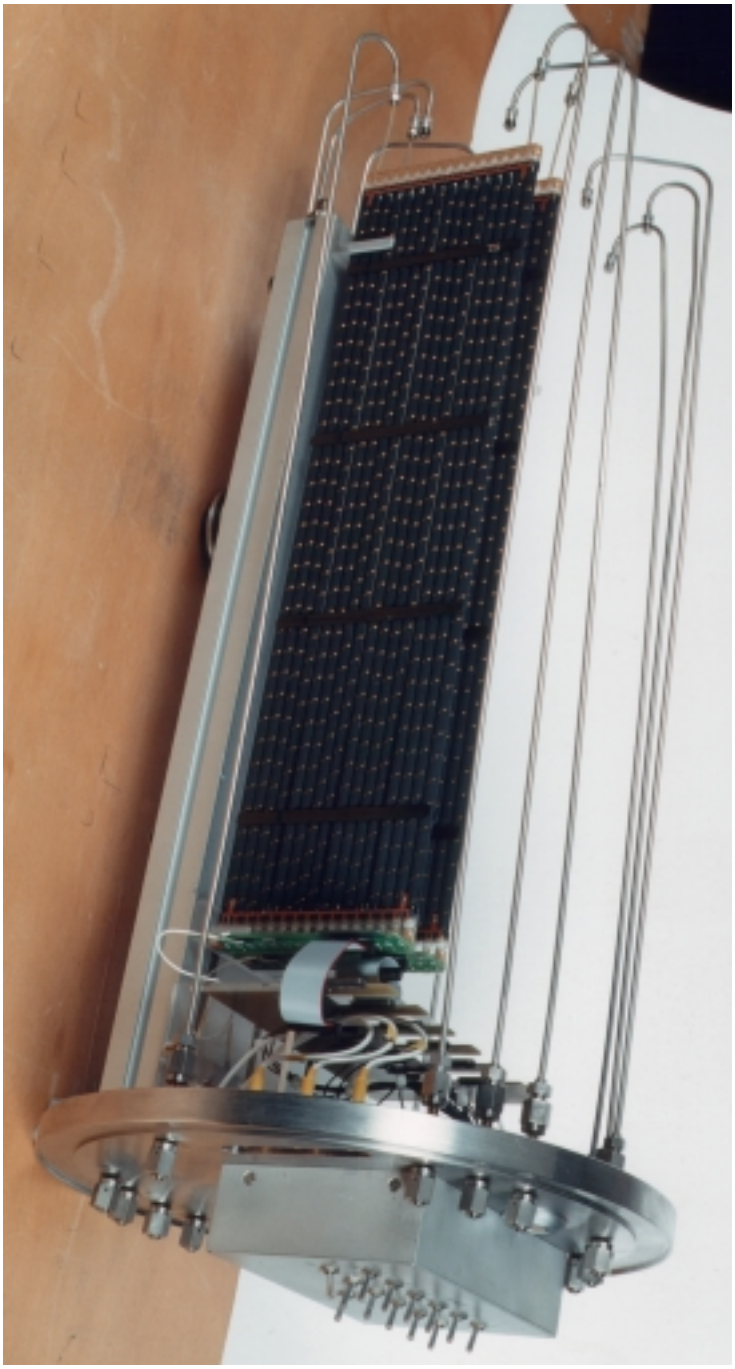
- dark currents:
  - $\mathrm{I_W}$
  - $\mathrm{I_T}$
  - $\mathrm{I_C}$

ST: Serial Test

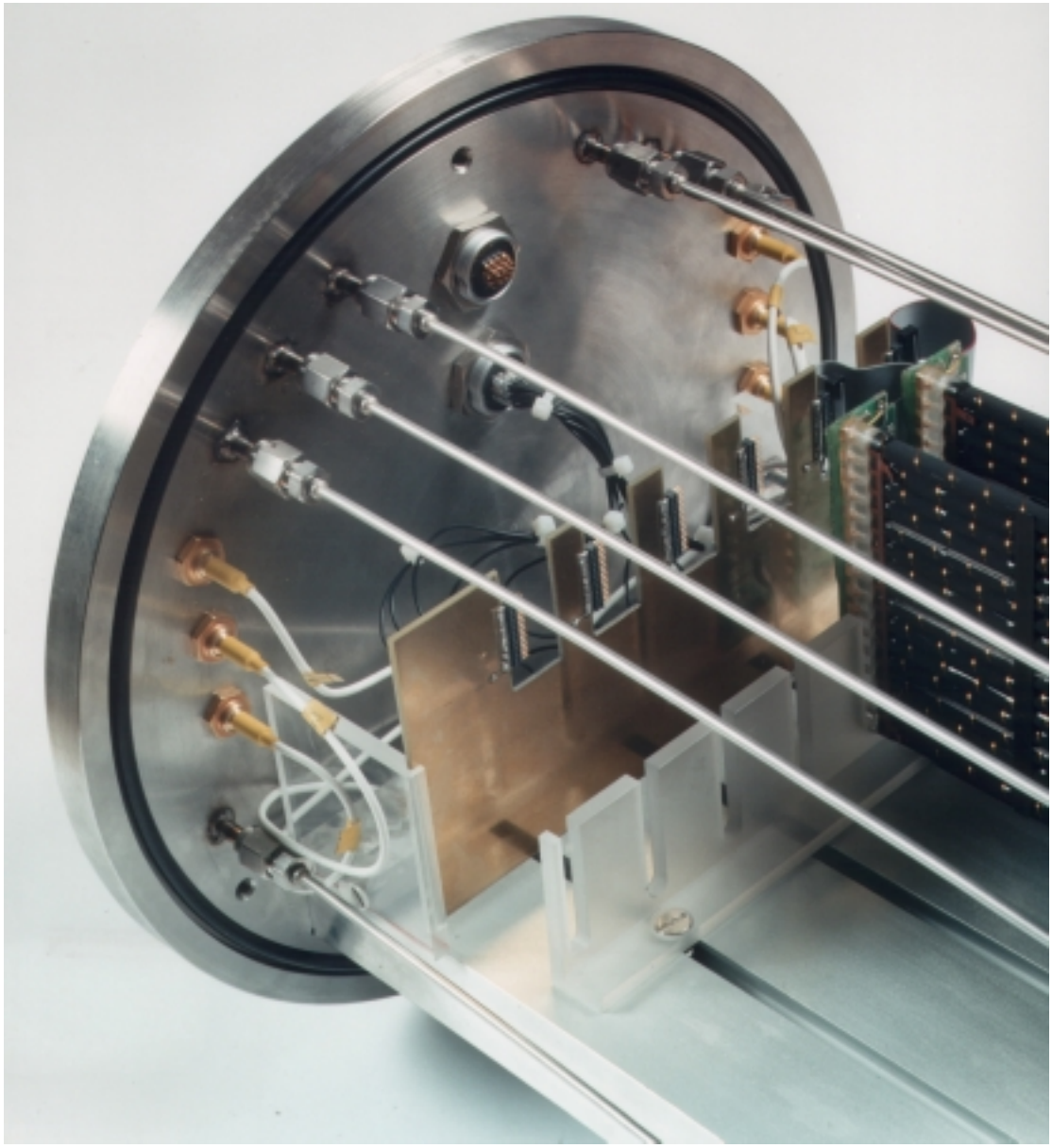




ST: Serial Test

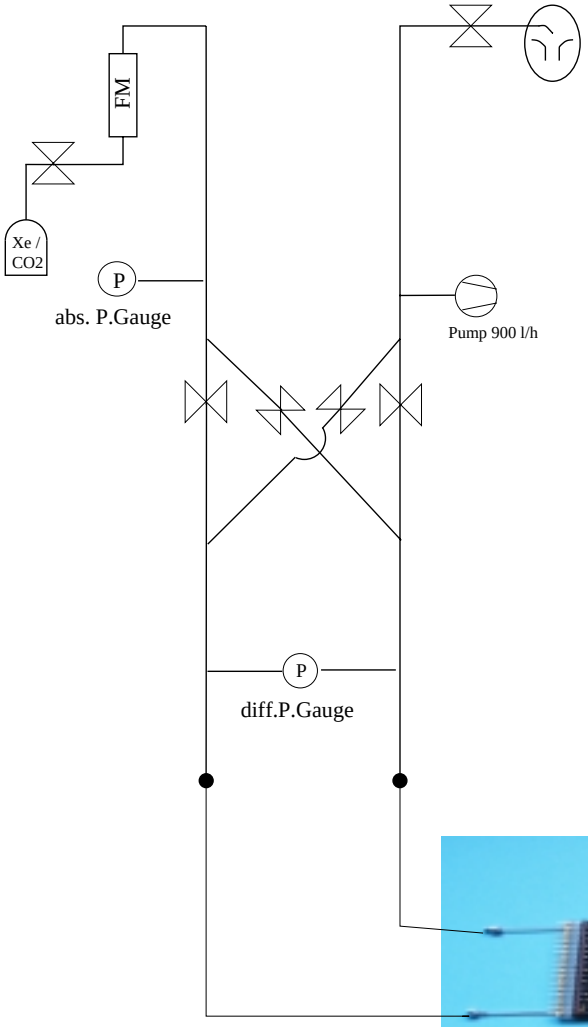


ST: Serial Test



GG: Gasgain Measurement

- Precalibration for all straws (Xe/CO_2) G(HV)

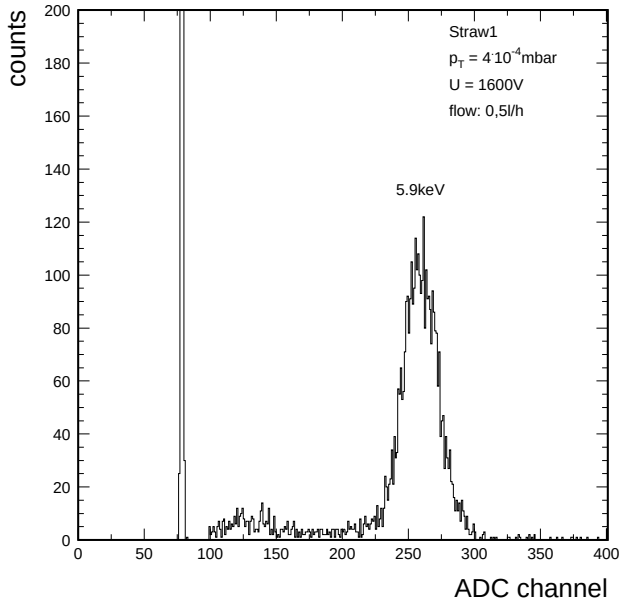


Quality Control:

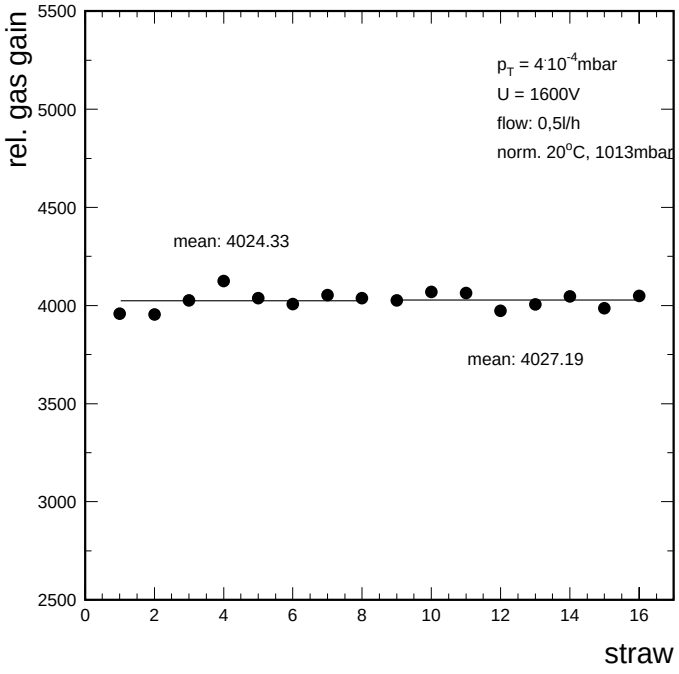
- straw to straw variation $< 10\%$
- module to module variation $< 20\%$

GG: Gasgain Measurement

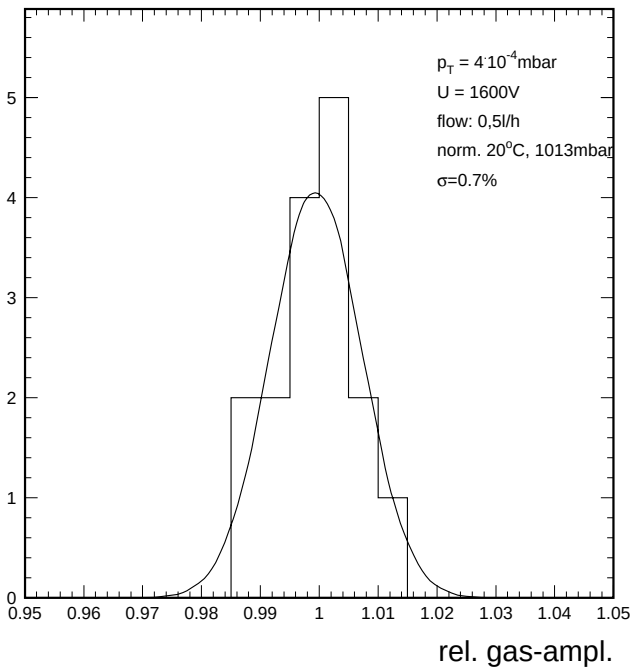
Gas Gain Measurement of Chamber 53 (Xe/CO_2) with ^{55}Fe



Gas Gain Measurement of Chamber 53 with ^{55}Fe



Gas Gain Measurement of Chamber 53 with ^{55}Fe



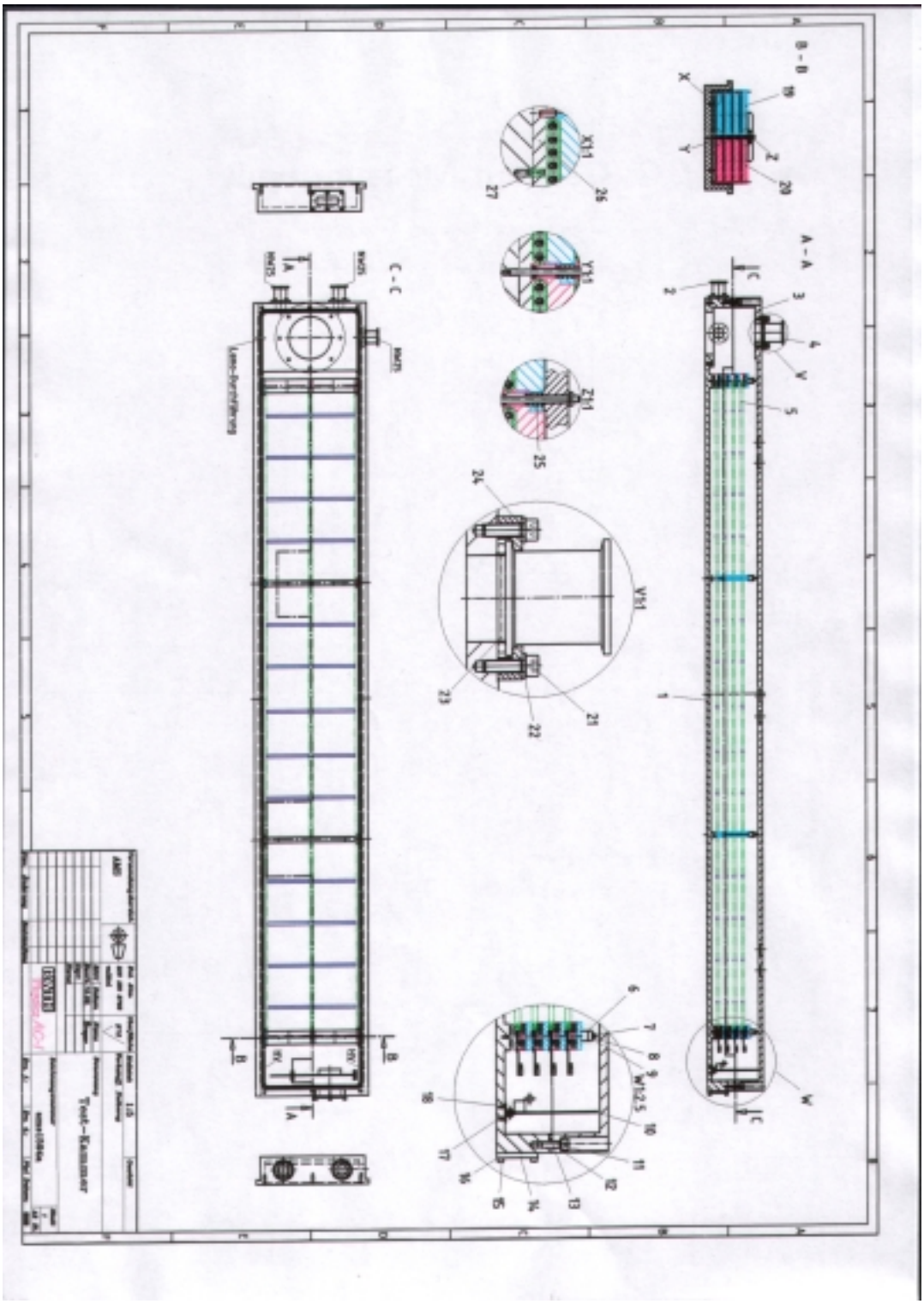
Long Term Test

8 Straw-modules = 1 TRD gasgroup

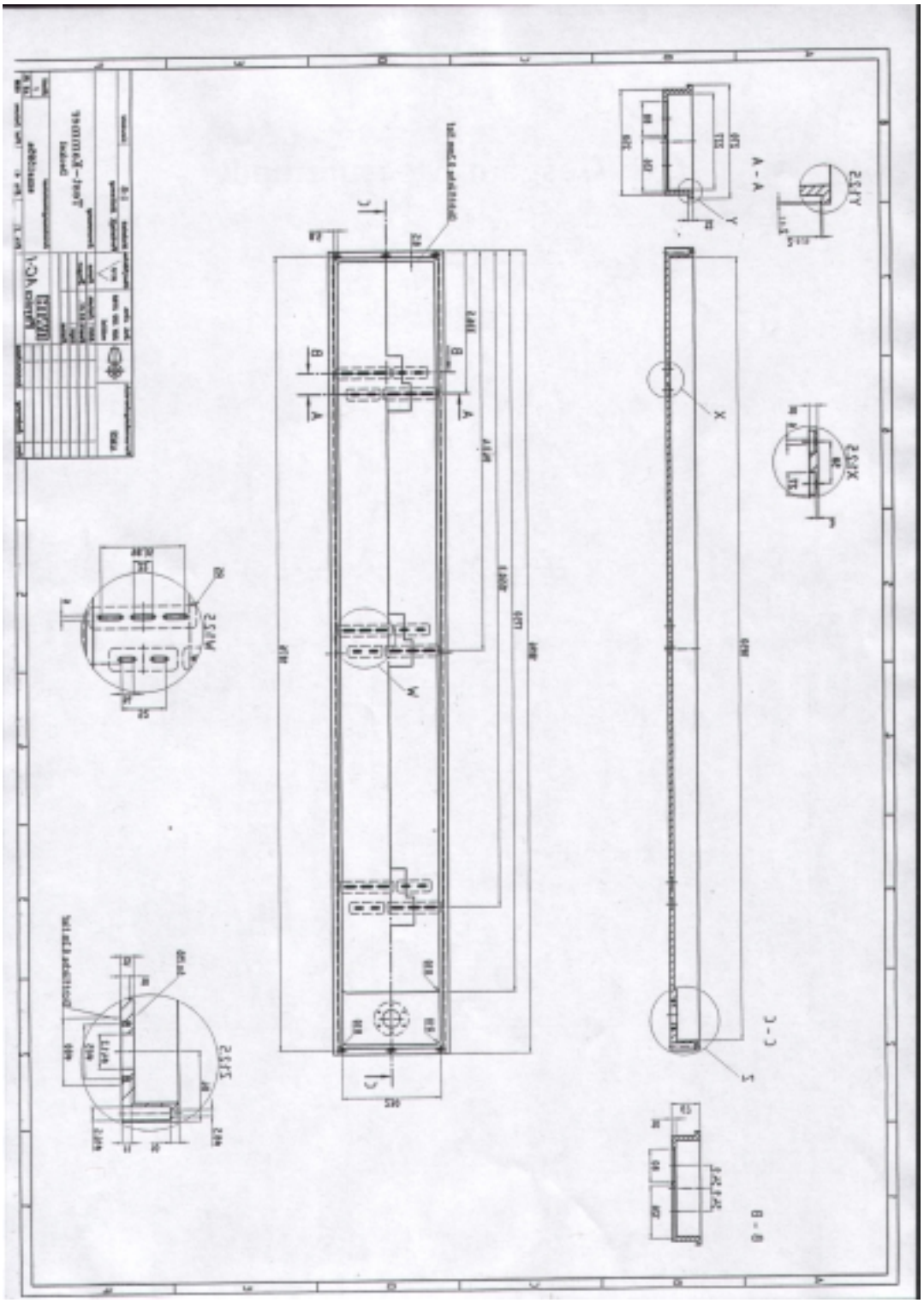
- Measurement of G(HV, ρ, t)

$\rightarrow$ Degradation of gasgain

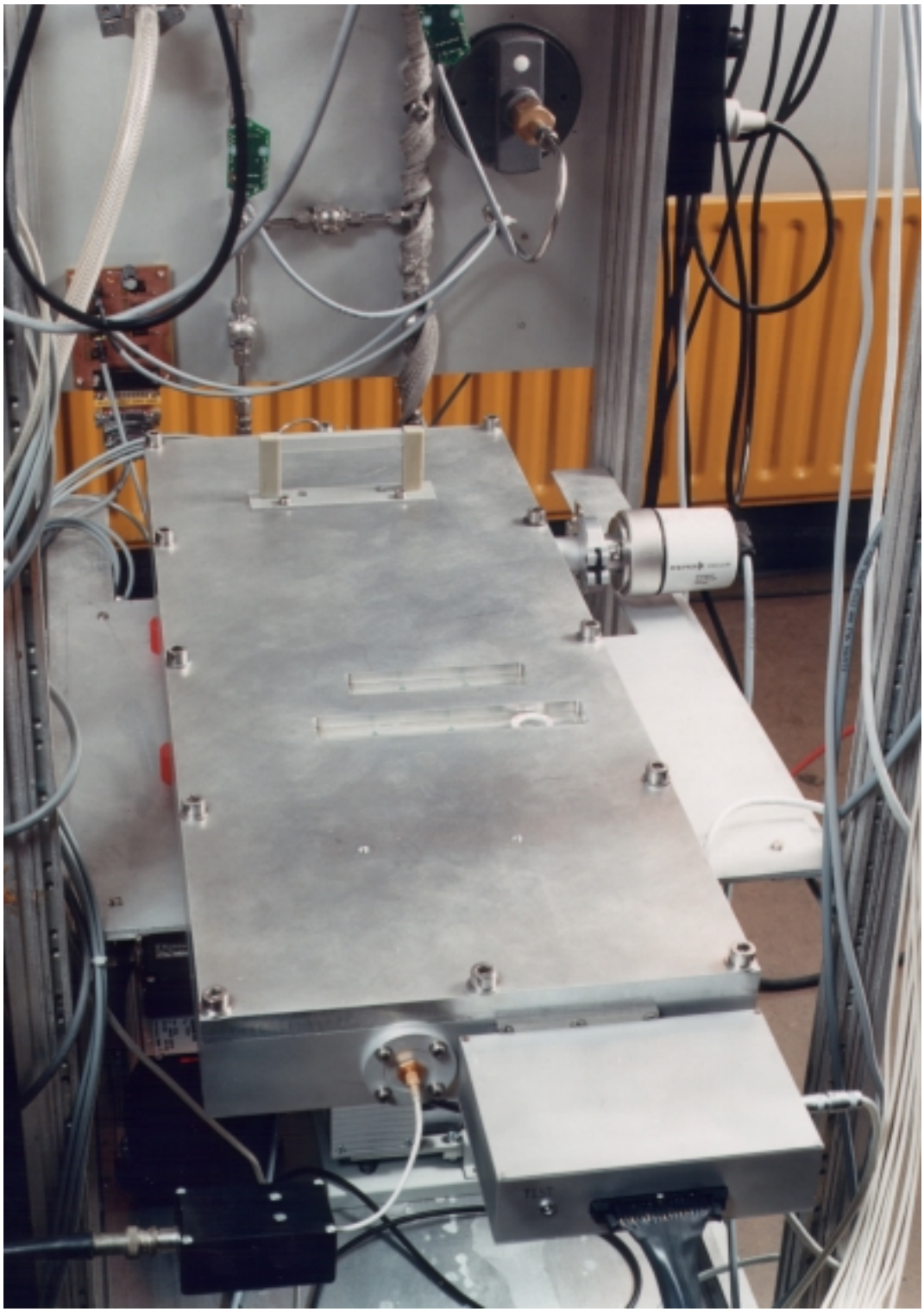
Long Term Test



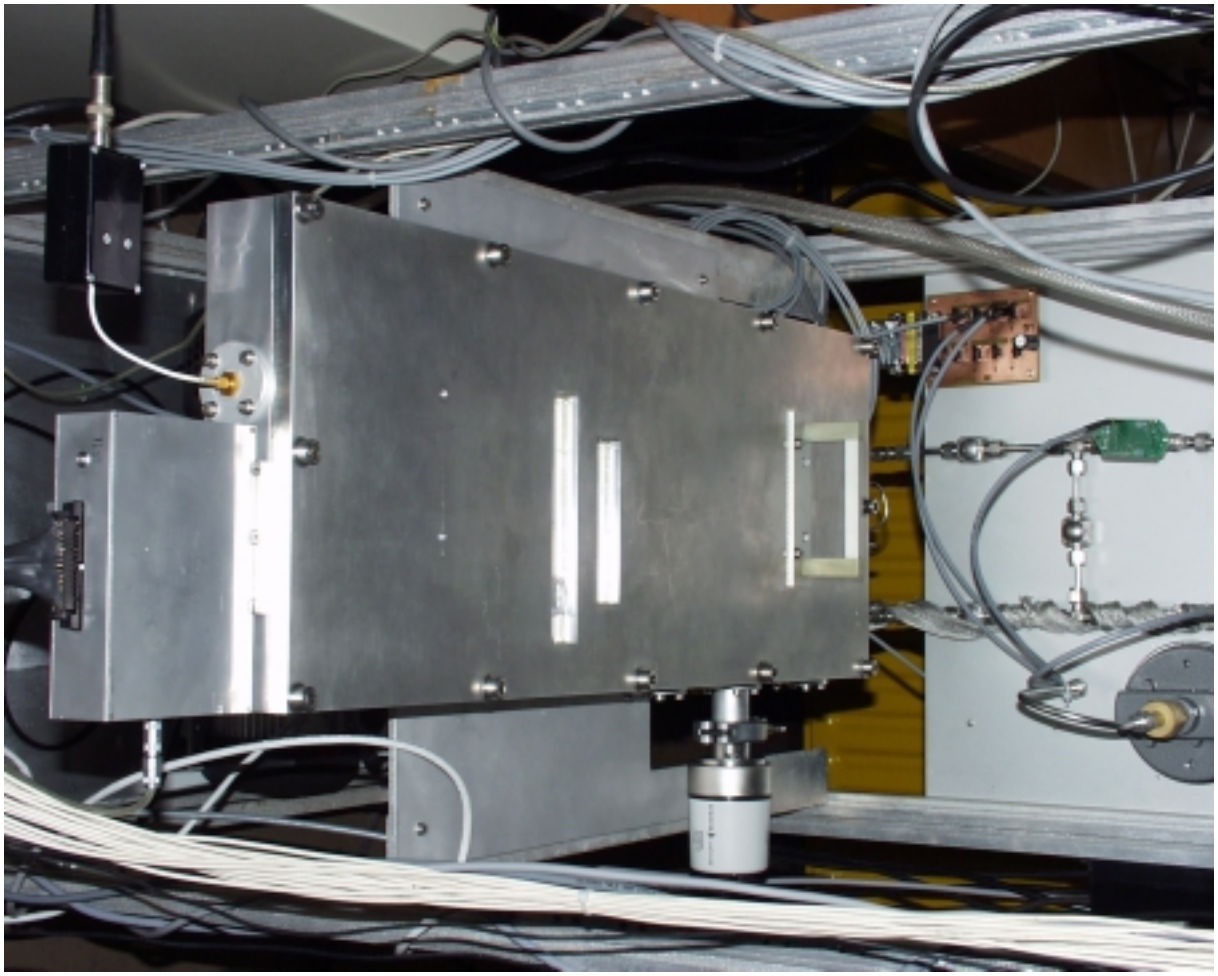
Long Term Test



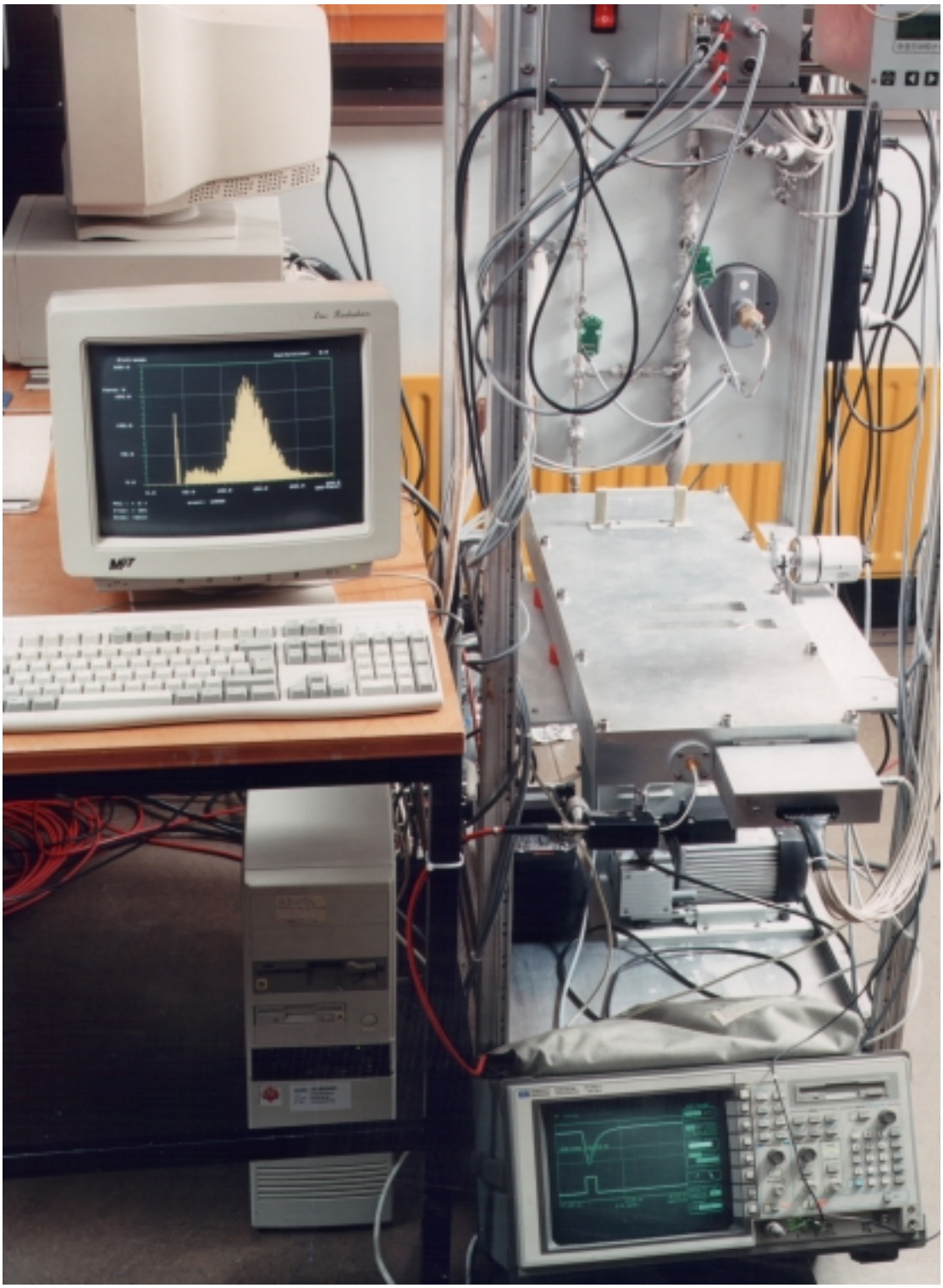
Long Term Test



Long Term Test



Long Term Test



Radiators

Th. Kirn

Radiators

1) LRP 375 BK vlies (used by ATLAS)

- fibermaterial: Polypropylene
- fiber thickness 10 μm
- density: 0.06 $\frac{\mathrm{g}}{\mathrm{cm}^3}$
- prize: 26.00 $\frac{\mathrm{DM}}{\mathrm{m}^2}$
- cleaning with CH_2Cl_2
  Extraction 3 hours at normal conditions
- prize: 100 $\frac{\mathrm{DM}}{\mathrm{m}^2}$

2) Separet 405

- fibermaterial: Polyacryl
- fiber thickness 14 μm
- density: 0.08 $\frac{\mathrm{g}}{\mathrm{cm}^3}$
- prize: 5.00 $\frac{\mathrm{DM}}{\mathrm{m}^2}$

1) + 2) manufacturer: Freudenberg Vliesstoffe KG
69465 Weinheim, Germany

Radiators, Outgassing

NASA-Tests:

- ASTM E 595 (thermal vacuum test I)
  - outgassing, evaporation under vacuum (screening test, 24 h at 125 ^{o}C)
    LIMITS: TML$\leq 1.0\%$**, CVCM** $\leq 0.1\%$

    TML: **T**otal **M**ass **L**oss

    CVCM: **C**ollected **V**olatile **C**ondensable **M**aterial

- ASTM E 1559 (thermal vacuum test II)
  - outgassing, evaporation, sublimation and redeposition test,
    mass-loss as a function of time,
    mass-loss after 144 h

Radiators, Outgassing

Deposition rate on nearby attached payloads:

LIMIT: $10^{-14}\ \frac{\mathrm{g}}{\mathrm{s}\cdot\mathrm{cm}^2}$

$\longrightarrow$ maximum allowable outgassed mass flow rate:
(2 vents diameter: 2.54 cm each)

$$1.4 \cdot 10^{-6} \frac{\mathrm{g}}{\mathrm{s}}$$

$\longrightarrow$ max. allowable outgassed mass flow rate of radiator: (total area of radiator $\approx 110\ m^2$)

$$1.2 \cdot 10^{-12} \frac{\mathrm{g}}{\mathrm{s}\cdot\mathrm{cm}^2}$$

Radiators, Outgassing

Austrian Research Center

Thermal Vacuum Test I, 24 h Screening Test

ESA-PSS01-702, ASTM E 595

LIMITS: TML $\leq 1.0\%$, CVCM $\leq 0.1\ \%$

Sample	TML (%)	WVR (%)	RML (%)	CVCM (%)
LRP 375BK				
not cleaned	0.22	0.02	0.20	-0.01
CH_2Cl_2	0.04	0.02	0.02	-0.01
Separet				
405	0.20	0.15	0.05	0.00

WVR: **W**ater **V**apour **R**egained

RML: **R**ecoverd **M**ass **L**oss

Thermal Vacuum Test II, 144 h Test

ESA-PSS01-702, ASTM E 1595

LIMIT : $1.2 \cdot 10^{-12} \frac{\mathrm{g}}{\mathrm{s \cdot cm^2}}$

LRP 375BK (CH_2Cl_2) : $1 \cdot 10^{-12} \frac{\mathrm{g}}{\mathrm{s \cdot cm^2}}$

Separet 405 : $2 \cdot 10^{-12} \frac{\mathrm{g}}{\mathrm{s \cdot cm^2}}$

Radiators, Outgassing

Lockheed Martin, ASTM E 1595

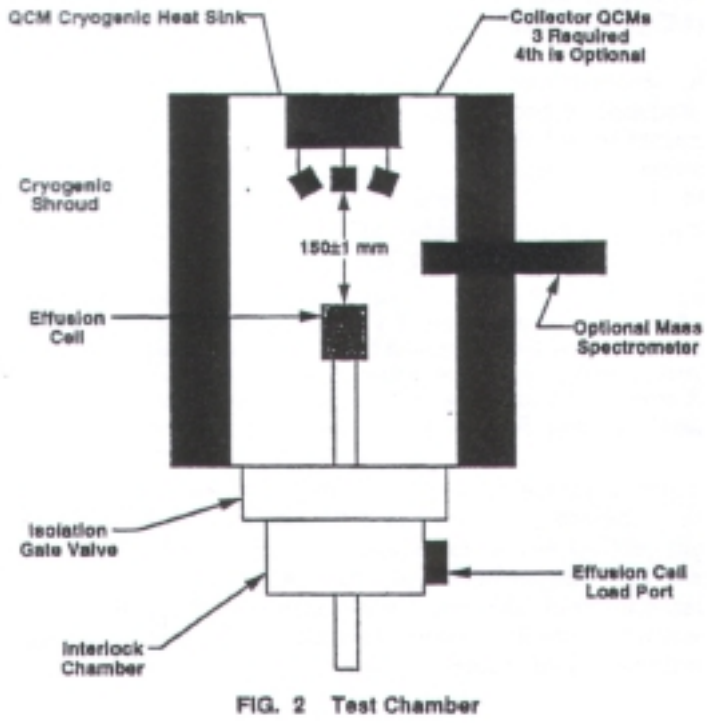


FIG. 2 Test Chamber

← 4 QCM's

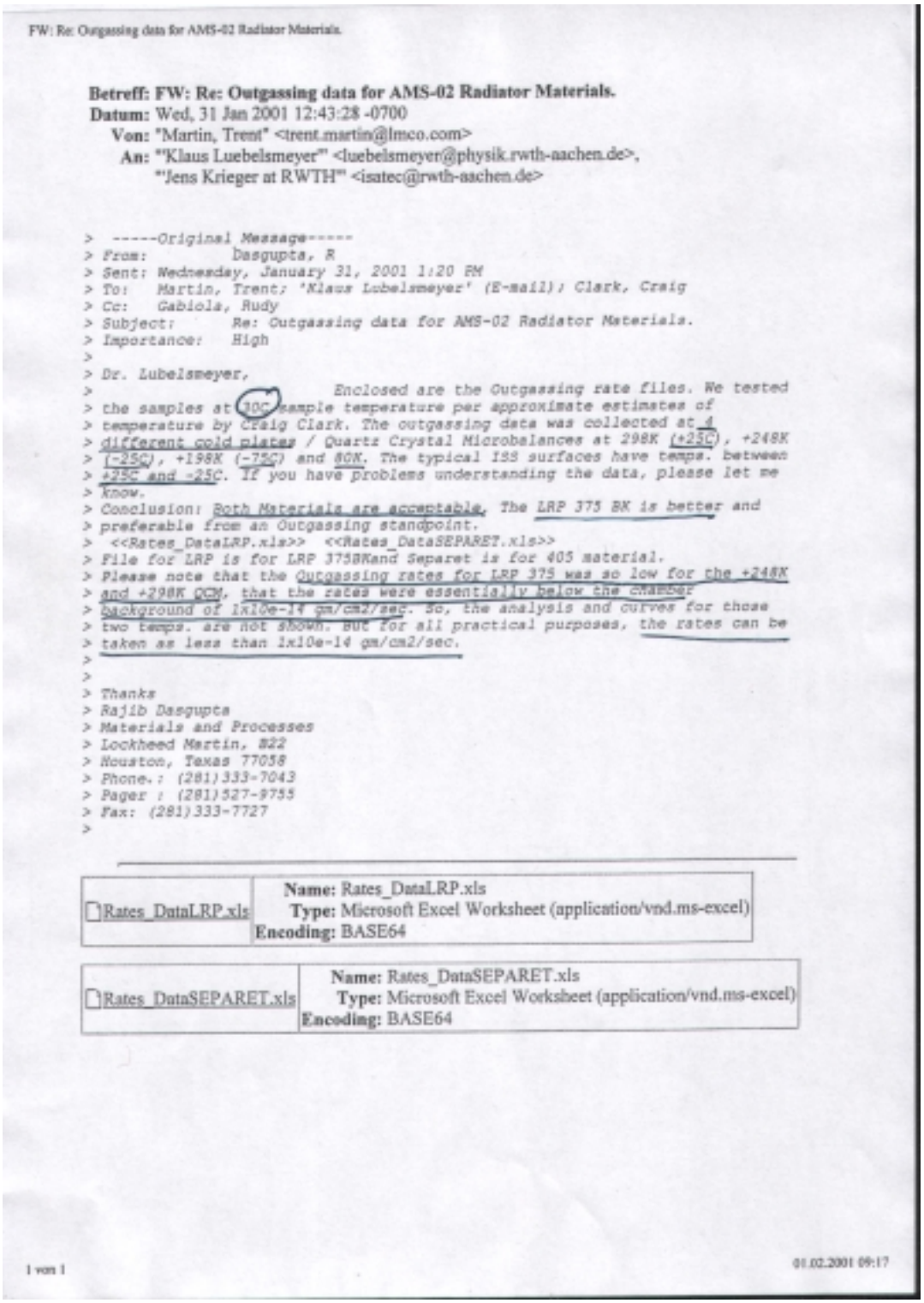
(quartz crystal microbalance)

$T_1 =$	298K	+25C
$T_2 =$	248K	-25C
$T_3 =$	198K	-75C
$T_4 =$	80K	-193C

Conclusion

- Both Materials are acceptable
- LRP 375 BK cleaned with CH_2Cl_2 is better
  → Outgassing rates for 248K and 298K QCM $\leq$ chamber background of $10^{-14}\frac{g}{cm^2 s}$

Radiators, Outgassing



FW: Re: Outgassing data for AMS-02 Radiator Materials.

Betreff: FW: Re: Outgassing data for AMS-02 Radiator Materials.
Datum: Wed, 31 Jan 2001 12:43:28 -0700
Von: "Martin, Trent" <trent.martin@lmco.com>
An: "Klaus Luebelsmeyer" <luebelsmeyer@physik.rwth-aachen.de>,
"Jens Krieger at RWTH" <isatec@rwth-aachen.de>

> -----Original Message-----
> From: Dasgupta, R
> Sent: Wednesday, January 31, 2001 1:20 PM
> To: Martin, Trent; 'Klaus Lubelsmeyer' (E-mail); Clark, Craig
> Cc: Gabiola, Rudy
> Subject: Re: Outgassing data for AMS-02 Radiator Materials.
> Importance: High
>
> Dr. Lubelsmeyer,
>
> Enclosed are the Outgassing rate files. We tested
> the samples at 30C sample temperature per approximate estimates of
> temperature by Craig Clark. The outgassing data was collected at 4
> different cold plates / Quartz Crystal Microbalances at 298K (+25C), +248K
> (-25C), +198K (-75C) and 80K. The typical ISS surfaces have temps. between
> +25C and -25C. If you have problems understanding the data, please let me
> know.
> Conclusion: Both Materials are acceptable. The LRP 375 BK is better and
> preferable from an Outgassing standpoint.
> <<Rates_DataLRP.xls>> <<Rates_DataSEPARET.xls>>
> File for LRP is for LRP 375BKand Separet is for 405 material.
> Please note that the Outgassing rates for LRP 375 was so low for the +248K
> and +298K QCM, that the rates were essentially below the chamber
> background of 1x10e-14 gm/cm2/sec. So, the analysis and curves for those
> two temps. are not shown. But for all practical purposes, the rates can be
> taken as less than 1x10e-14 gm/cm2/sec.
>
>
> Thanks
> Rajib Dasgupta
> Materials and Processes
> Lockheed Martin, B22
> Houston, Texas 77058
> Phone.: (281)333-7043
> Pager : (281)527-9755
> Fax: (281)333-7727
>

Rates_DataLRP.xls	**Name:** Rates_DataLRP.xls **Type:** Microsoft Excel Worksheet (application/vnd.ms-excel) **Encoding:** BASE64

Rates_DataSEPARET.xls	**Name:** Rates_DataSEPARET.xls **Type:** Microsoft Excel Worksheet (application/vnd.ms-excel) **Encoding:** BASE64

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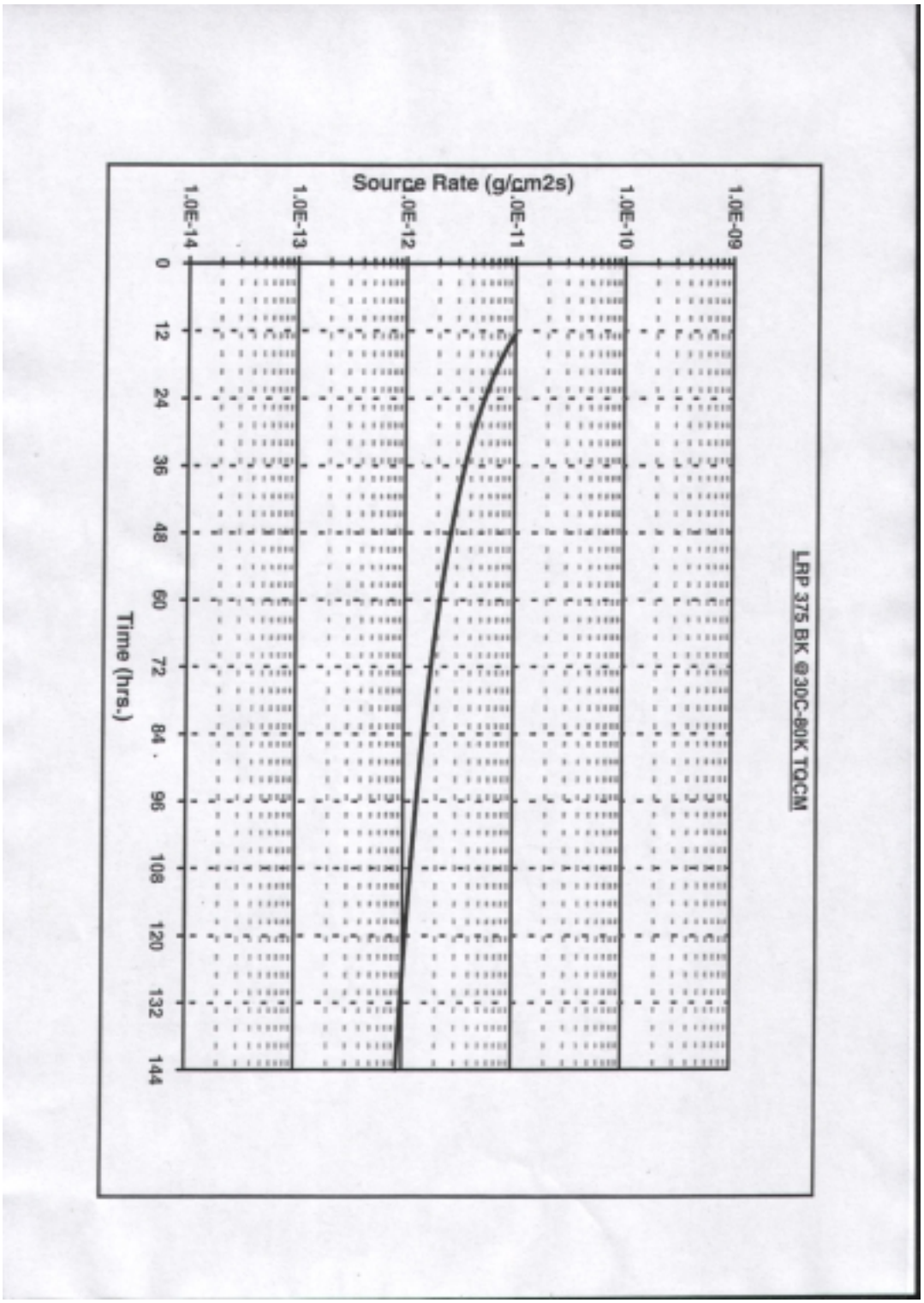
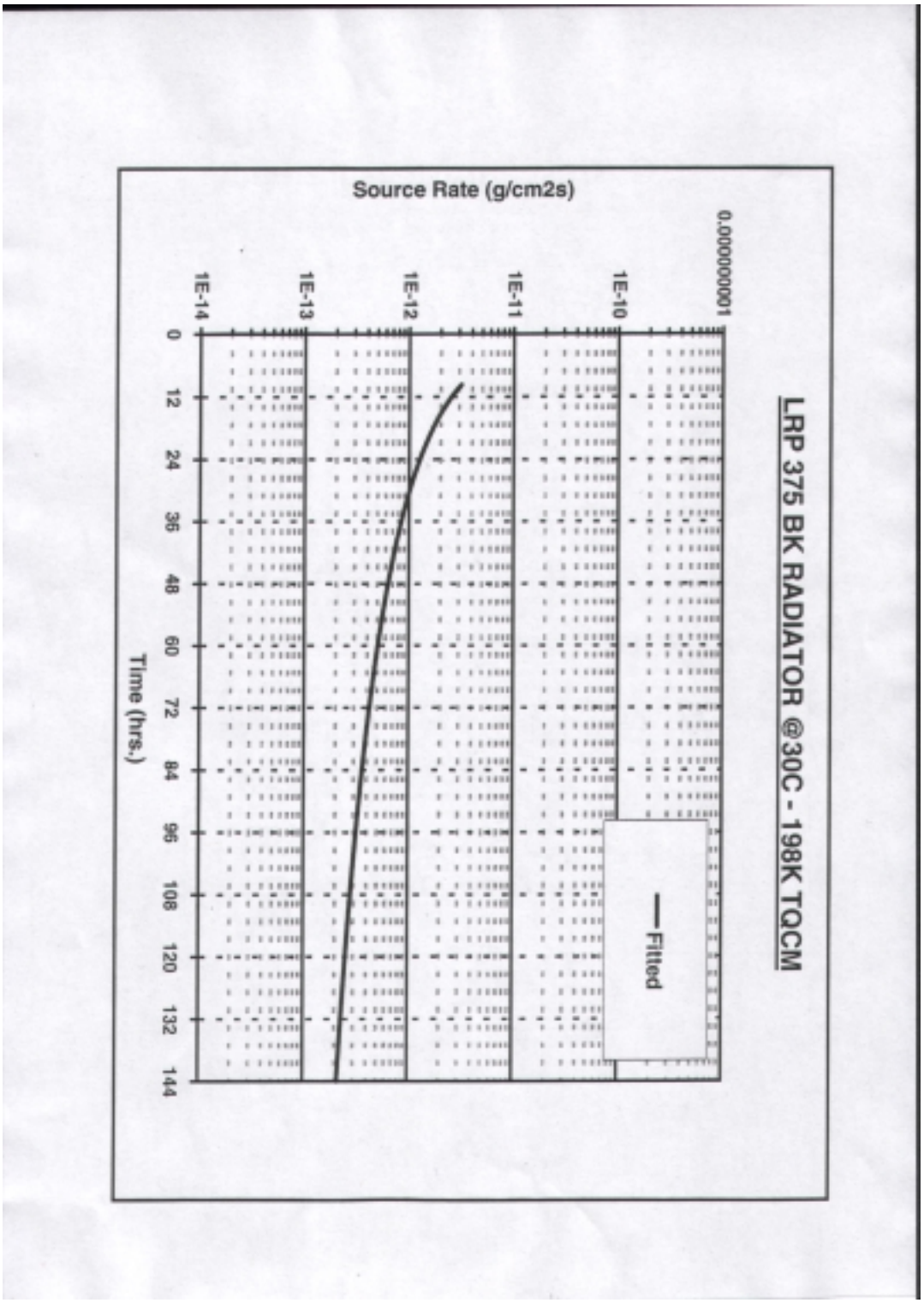
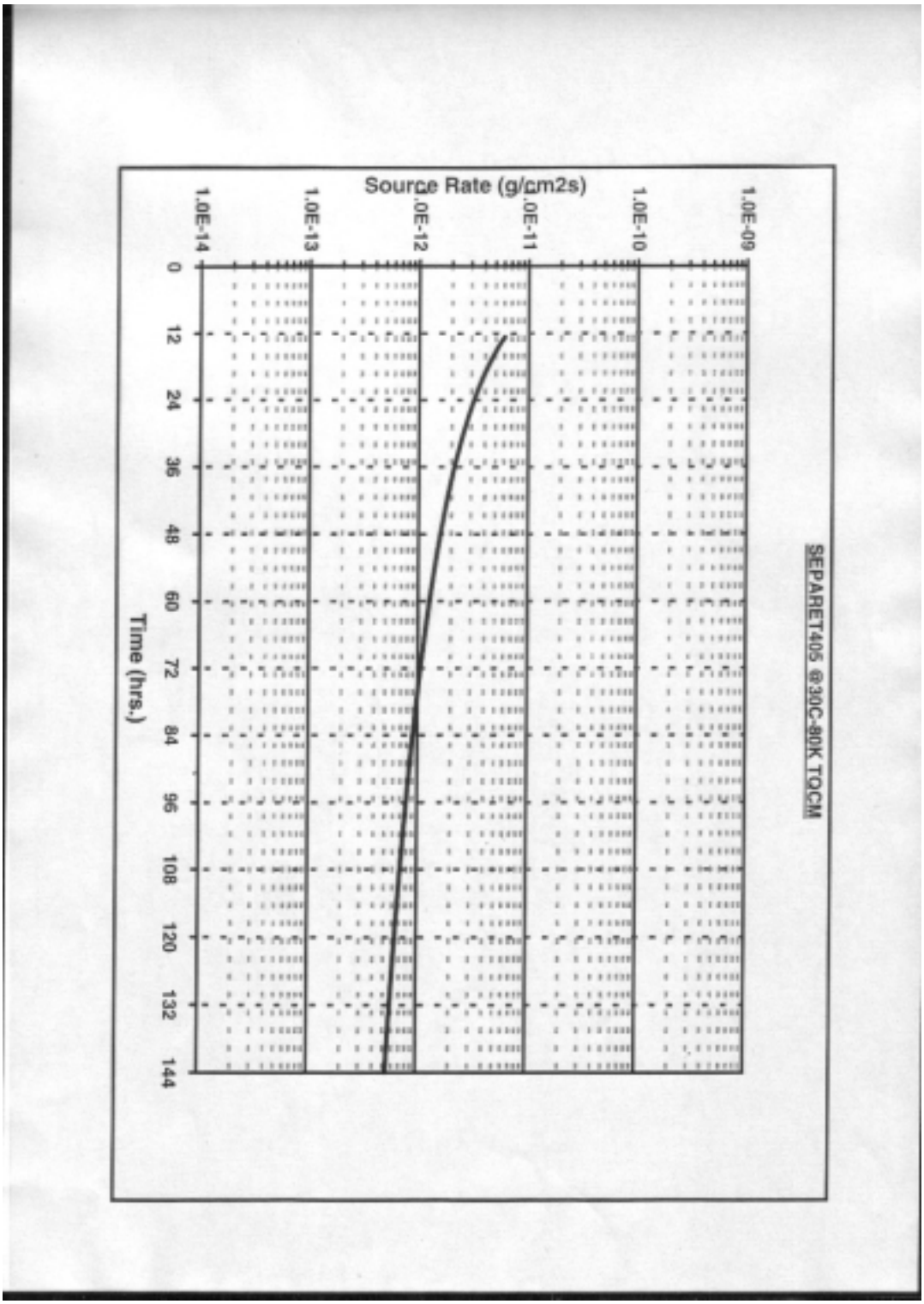
Radiators, Outgassing



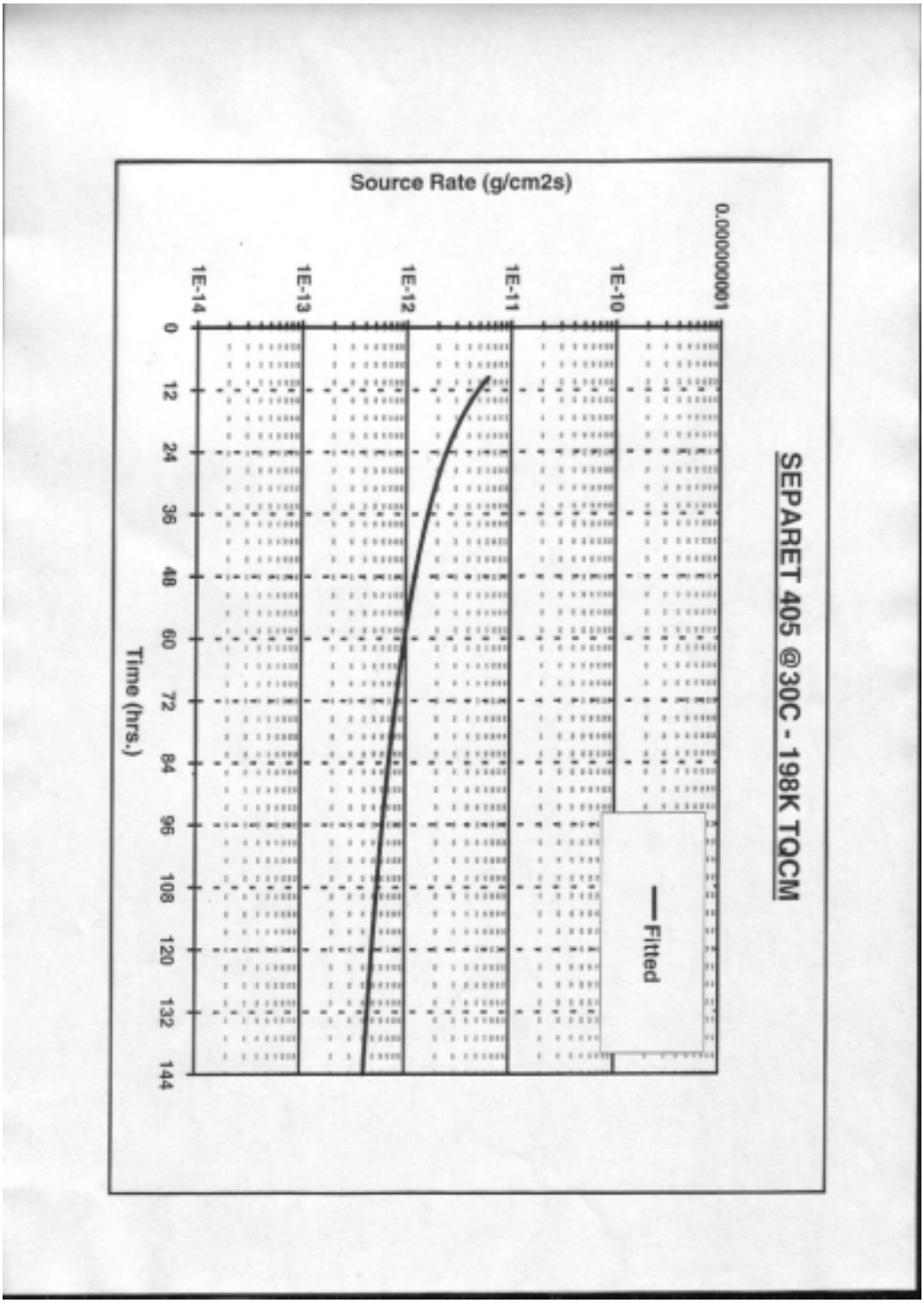
Radiators, Outgassing



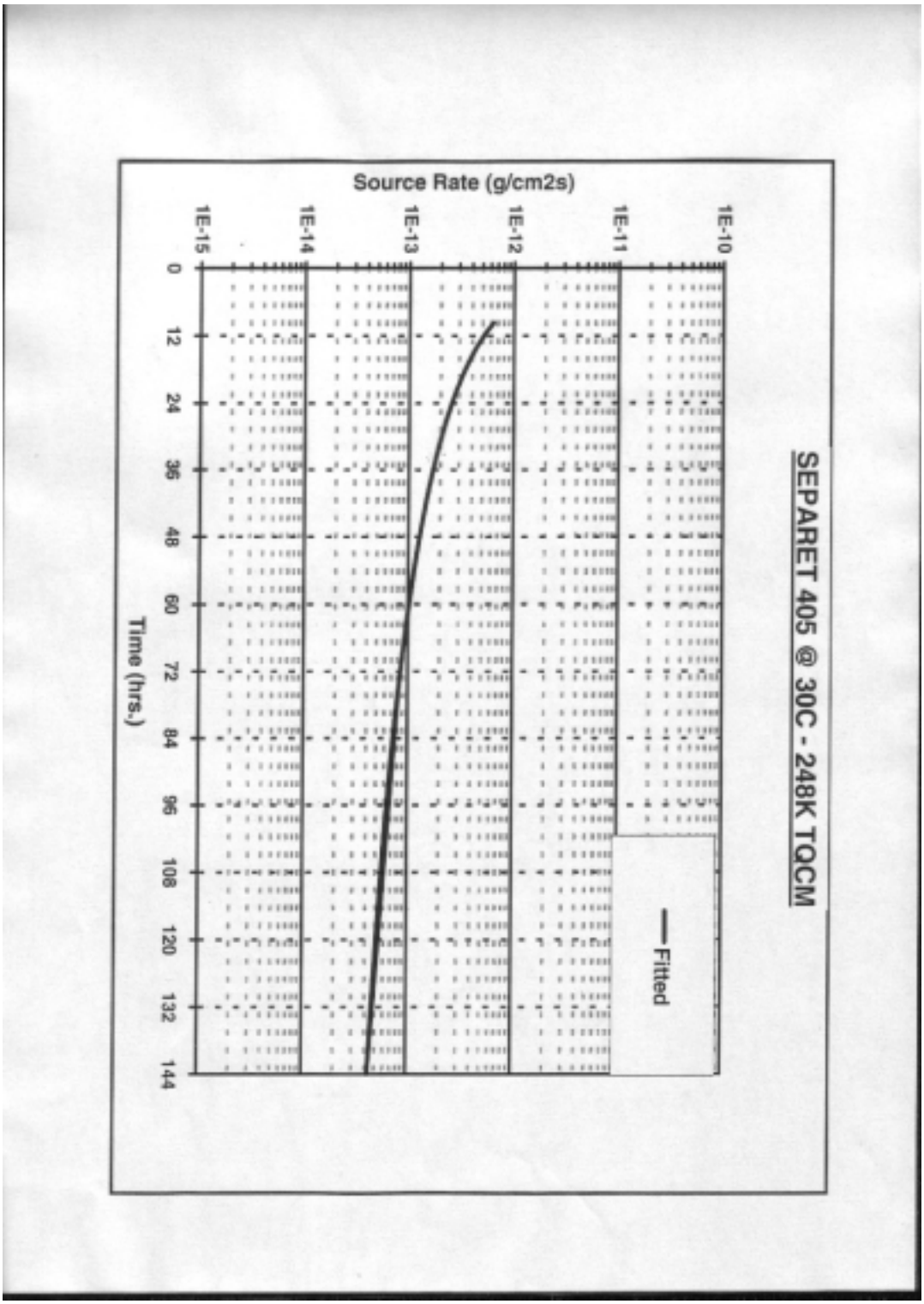
Radiators, Outgassing



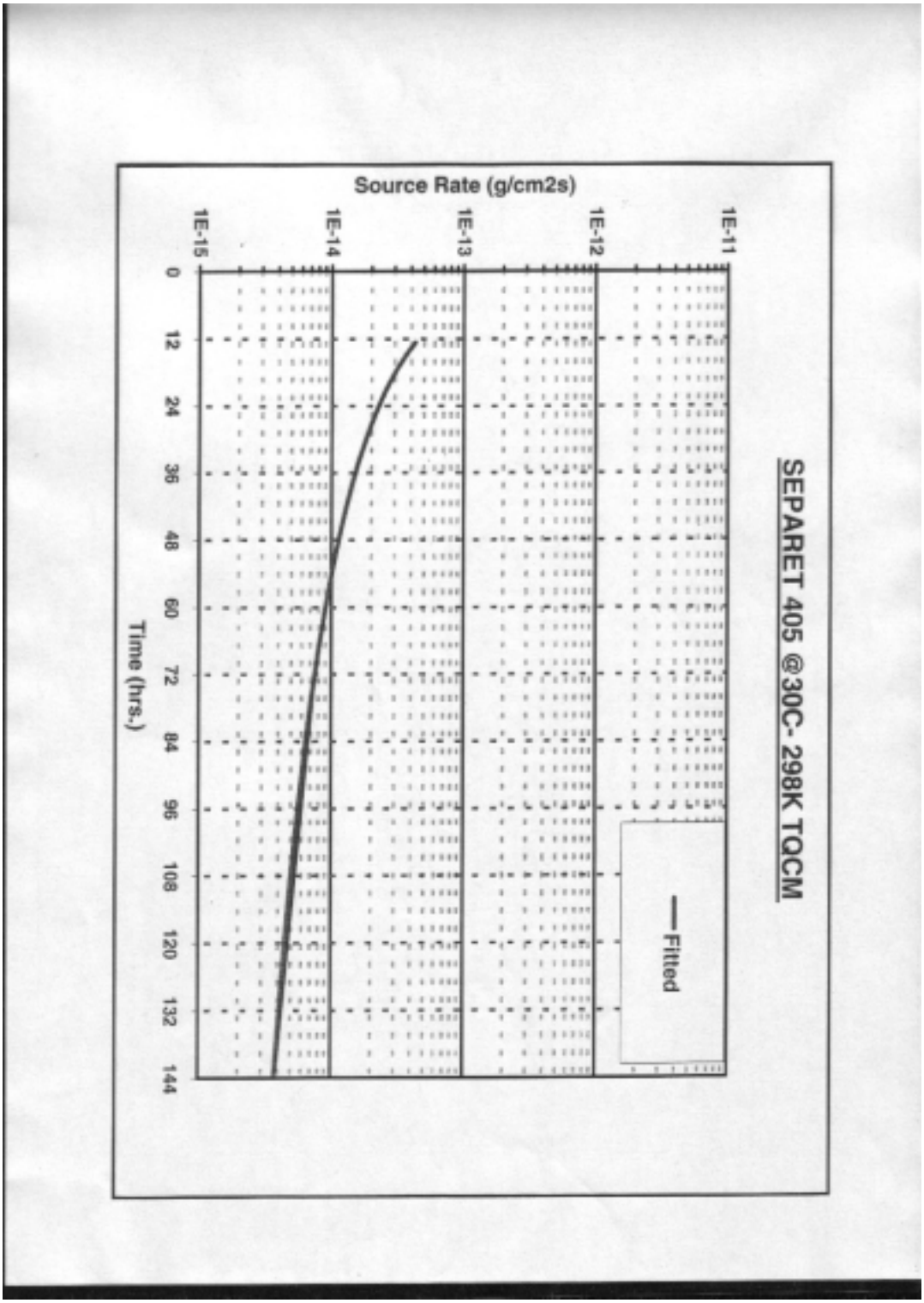
Radiators, Outgassing



Radiators, Outgassing

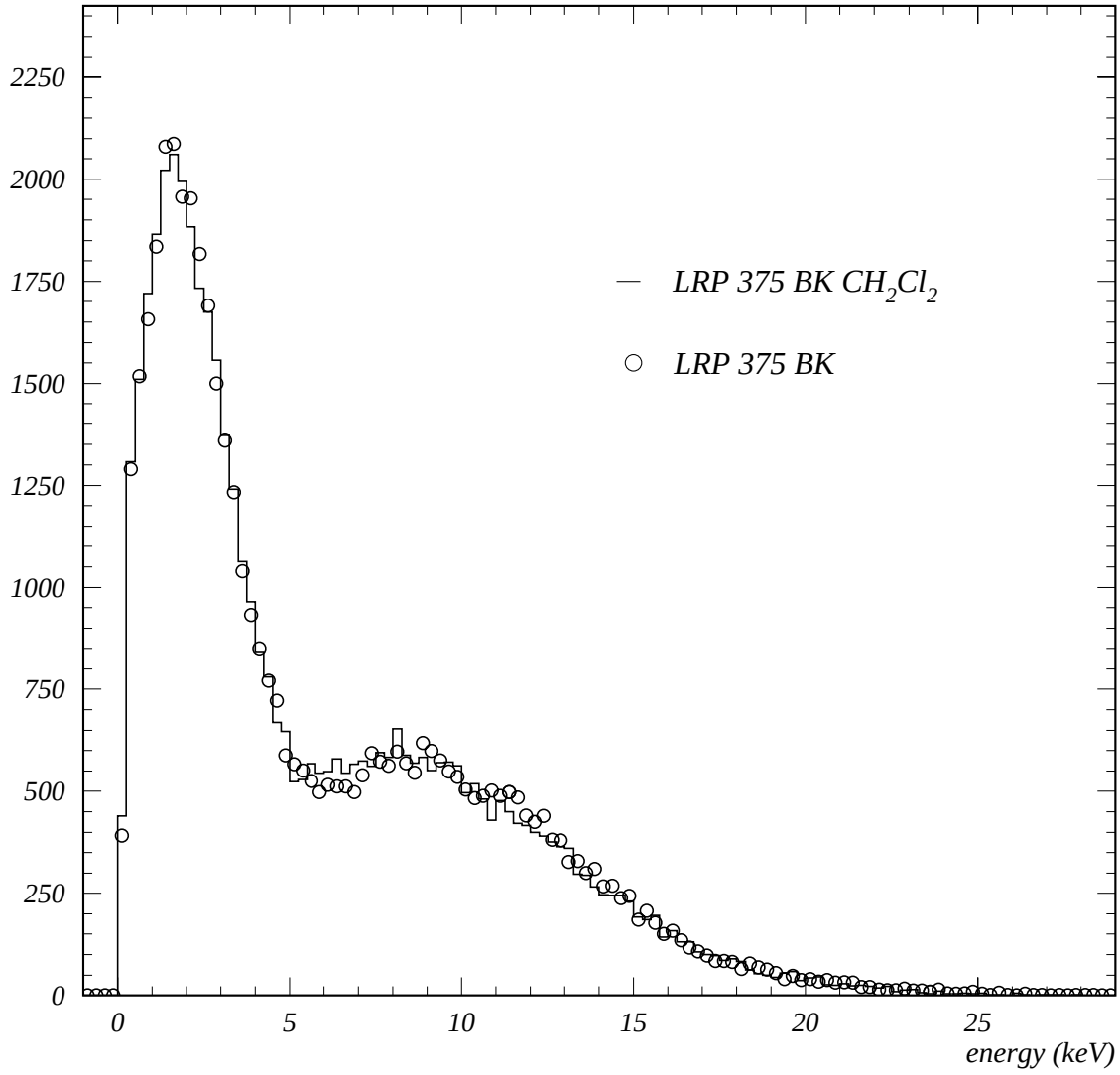


Radiators, Outgassing



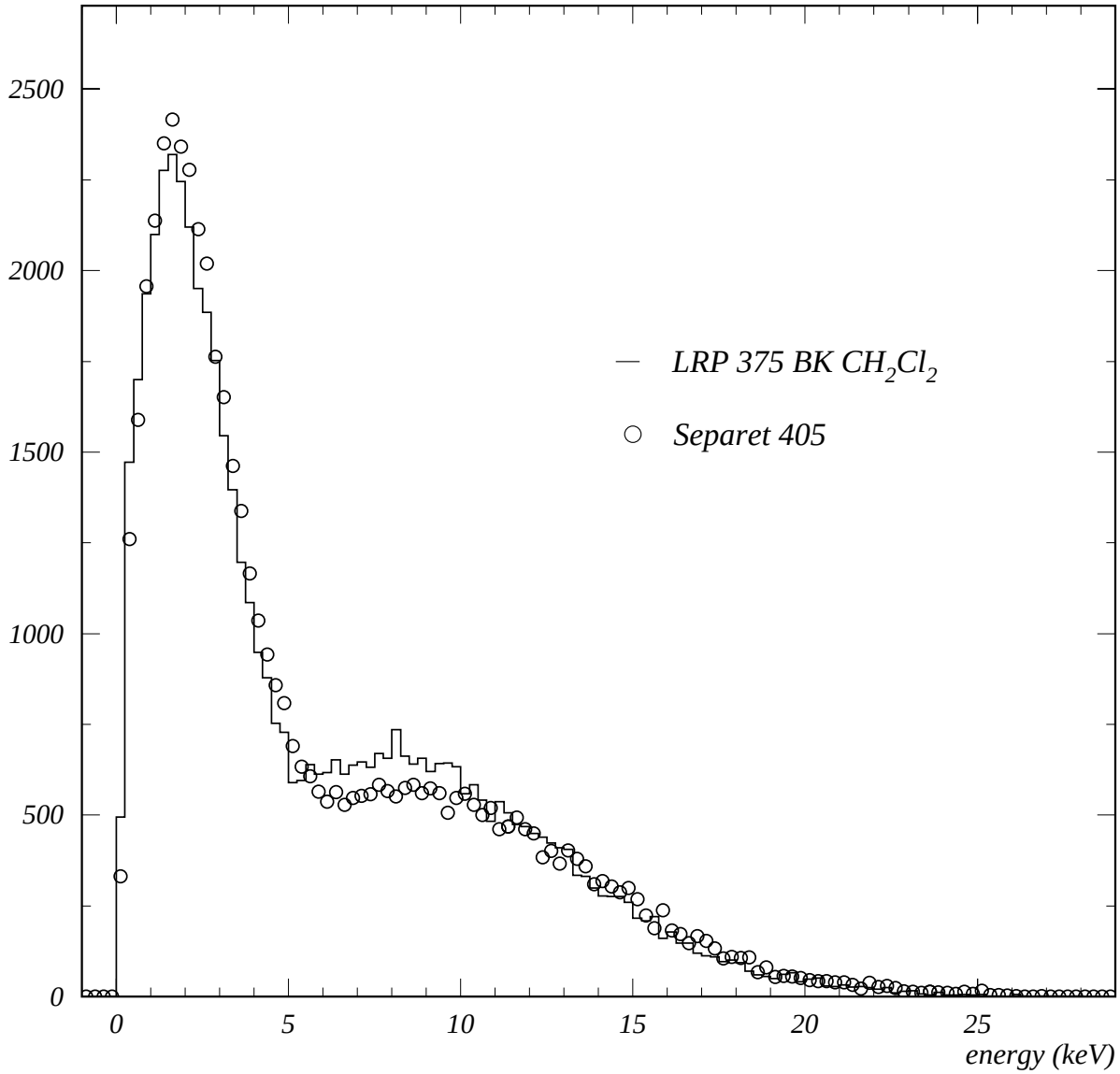
Radiators, Testbeam

P-Tower: 4 Layers LRP 375 BK
4 Layers LRP 375 BK cleaned with CH_2Cl_2
4 Layers Separet 405
Run 435, 20 GeV electron



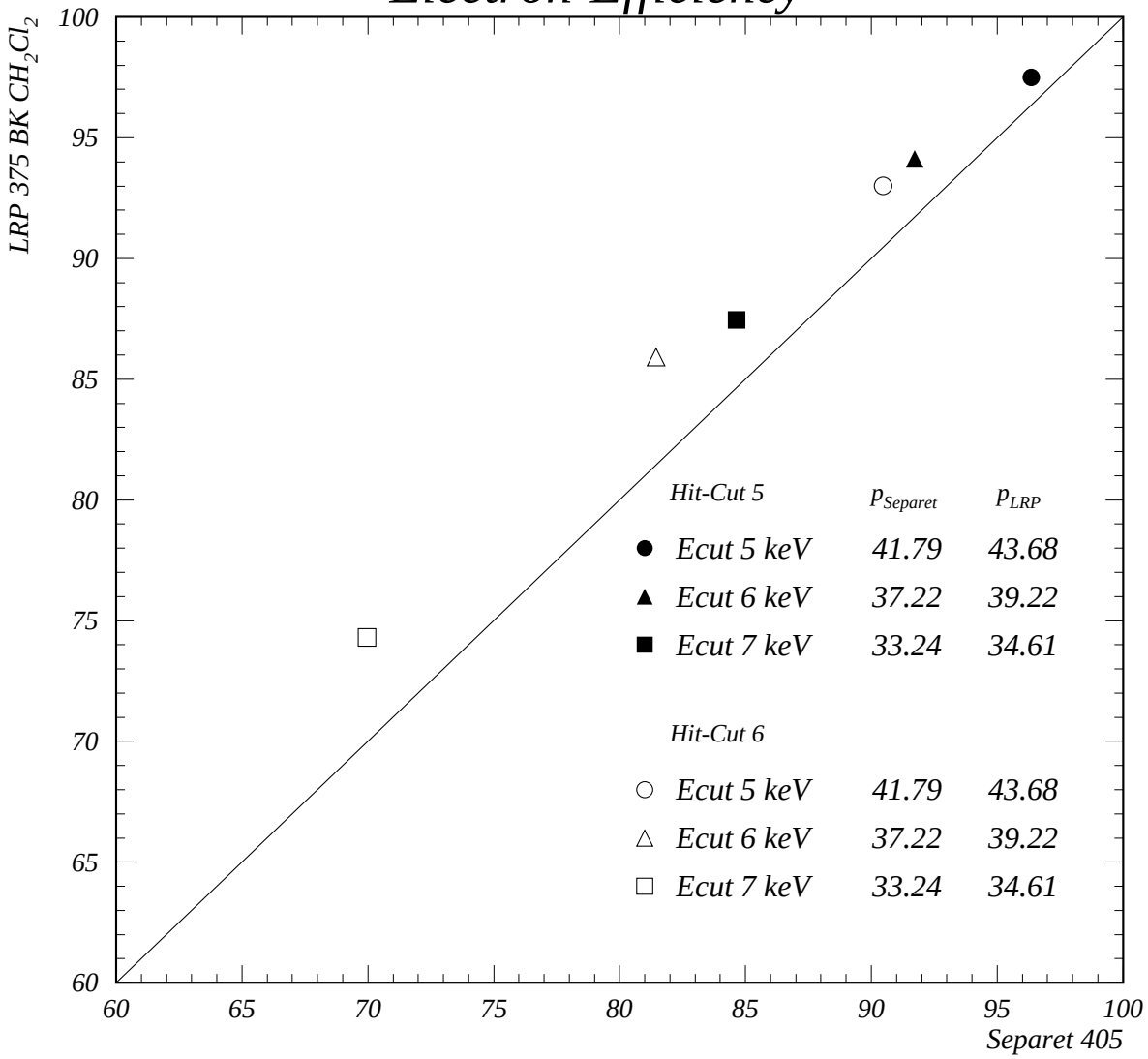
Radiators, Testbeam

Run 435, 20 GeV electron



Radiators, Testbeam

Run 435, 20 GeV electron



Radiators, Conclusion

Outgassing Testbeam Weight

↘ ↓ ↙

LRP 375 BK

+ CH_2Cl_2-cleaning

↑

Organic Chemistry Institute of RWTH-Aachen:
Development of 10 soxhlett extraction setups for
360 m^2 of LRP 375 BK