Status of electro polishing

At DESY A.Matheisen
At Saclay informations supplied by C.Antoin

See also contributions of E.Palmirie and C.Antoin to the CARE meeting this afternoon and lab talks of yesterday

Part 1 status at Saclay
Part 2 Status at DESY

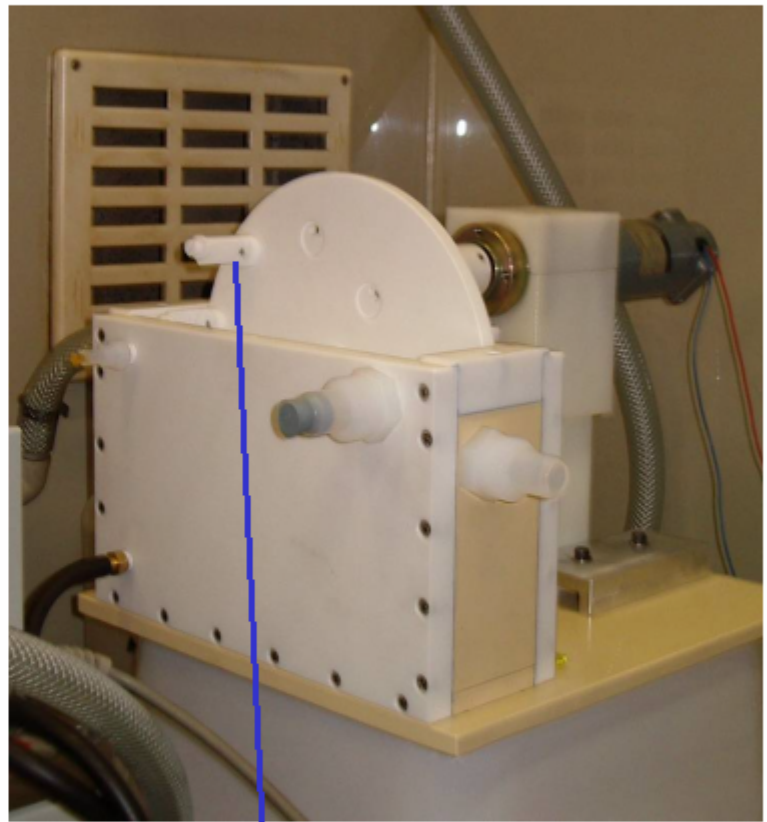
Saclay's Program to W5-1 EP of monocell

- Optimization of the process on samples
- Built up of a simplified EP facility (monocell)
- Adapt the parameters from sample to monocell facility, compare EP and FNP

Note: this program takes place in a more general program of the lab that aims to determine the origin of the quench vs surface treatment

Samples facilities

- standard EP reactor
- rotating sample holder =>
  - same anode cathode distance
  - reproduces cavity rotation and sequential immersion in the polishing bath



Rotating sample holder with el. contact

General Program: cavities /samples

- Issue : E_{acc} max ~ 50 à 60 MV/m !?
- CAVITIES : RF Test
  - BCP vs EP
  - Localisation of quench *Already in progress*
  - Morphologic analysis *Already in progress*
- SAMPLES : Analysis
  - Contamination inside λ_L = f(surf. treatement) *Already in progress*
  - Reaction mecanismes during etching *Already in progress*
  - Grain boundary resistivity *Already in progress*
  - Surface morphology *Already in progress*
  - Thermal transfert *Already in progress*

EP : optimization of process

- Improvement of EP solution
  - Optimization of electric parameters *(in progress)*
    - Anode/cathode surface ratio
    - Anode/cathode distance

  (to be started in 2004)

  - Bath composition (close from present composition)
  - Aging of the bath : determination of limits of utilization
    Adjusting bath composition in time (filtration, acids addition)
  - Role/prevention of impurities and dissolved gases in the bath

- protection against hydrogen
  - identification of contaminating steps (confirmed)
  - Cathodic/anodic protection (failed)

Part 2 electro polishing at DESY

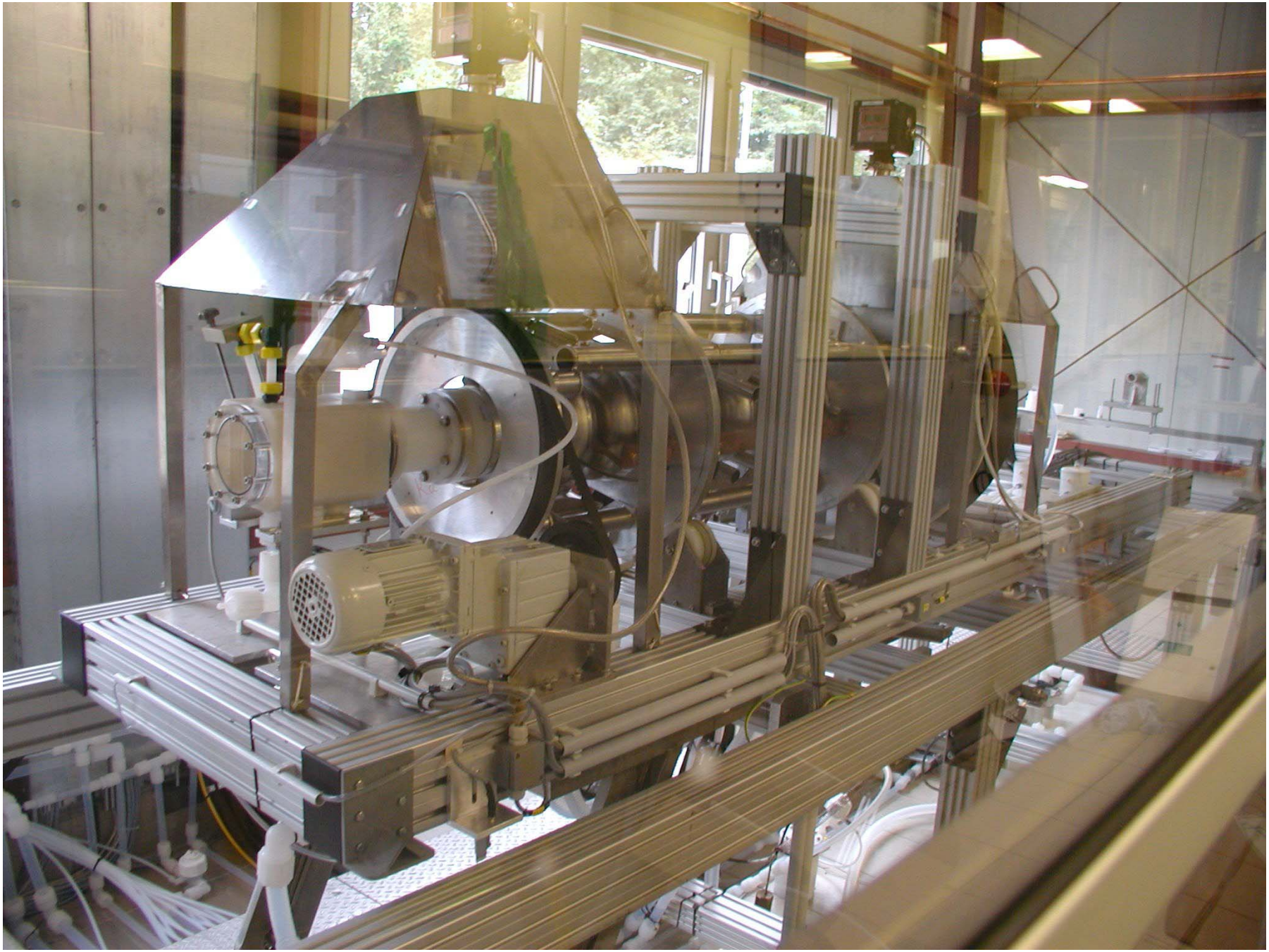
Parameter list

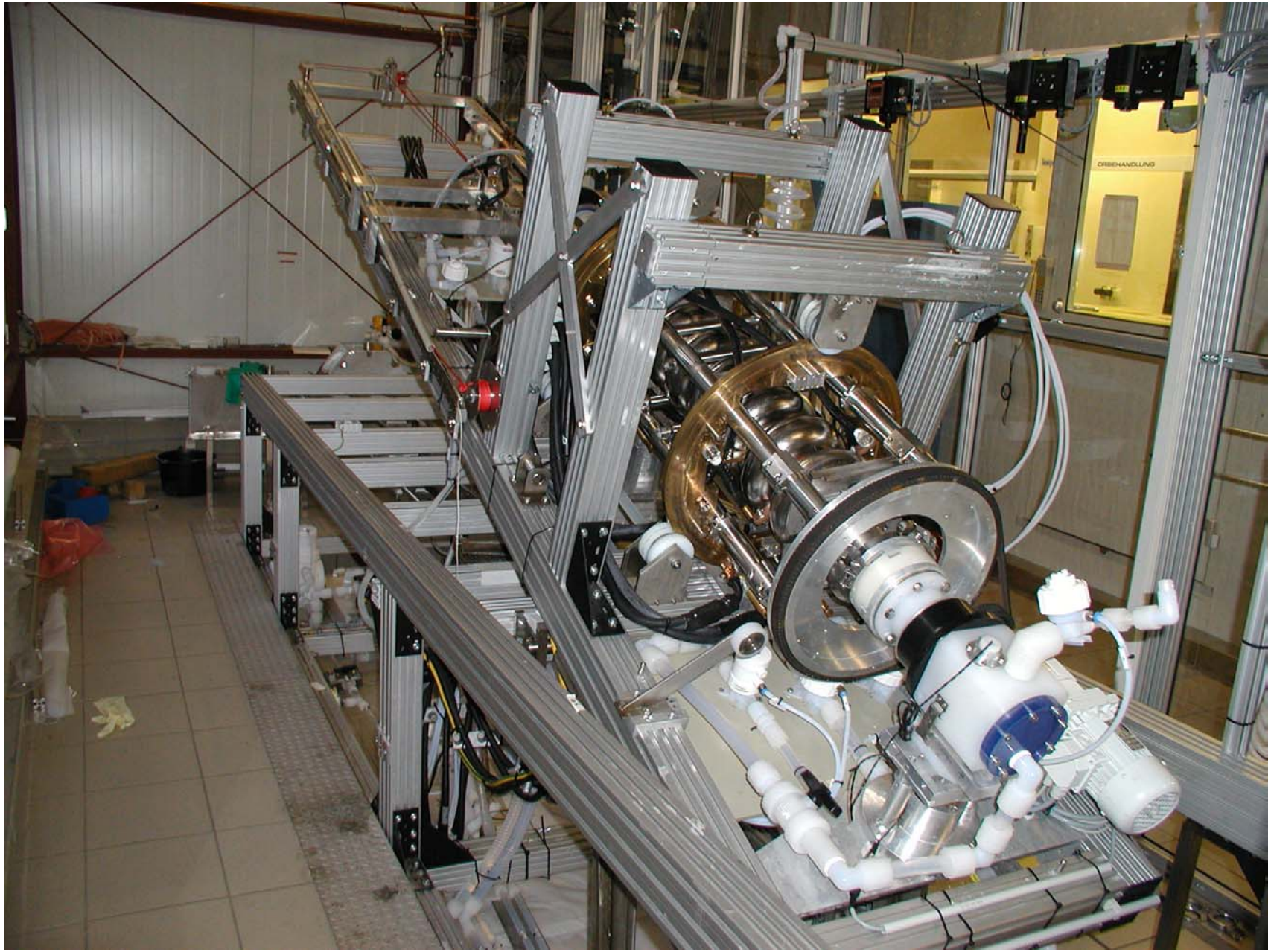
single cell		
	Surface area	1460 cm2
nine cell		
	Surface area	8820 cm2

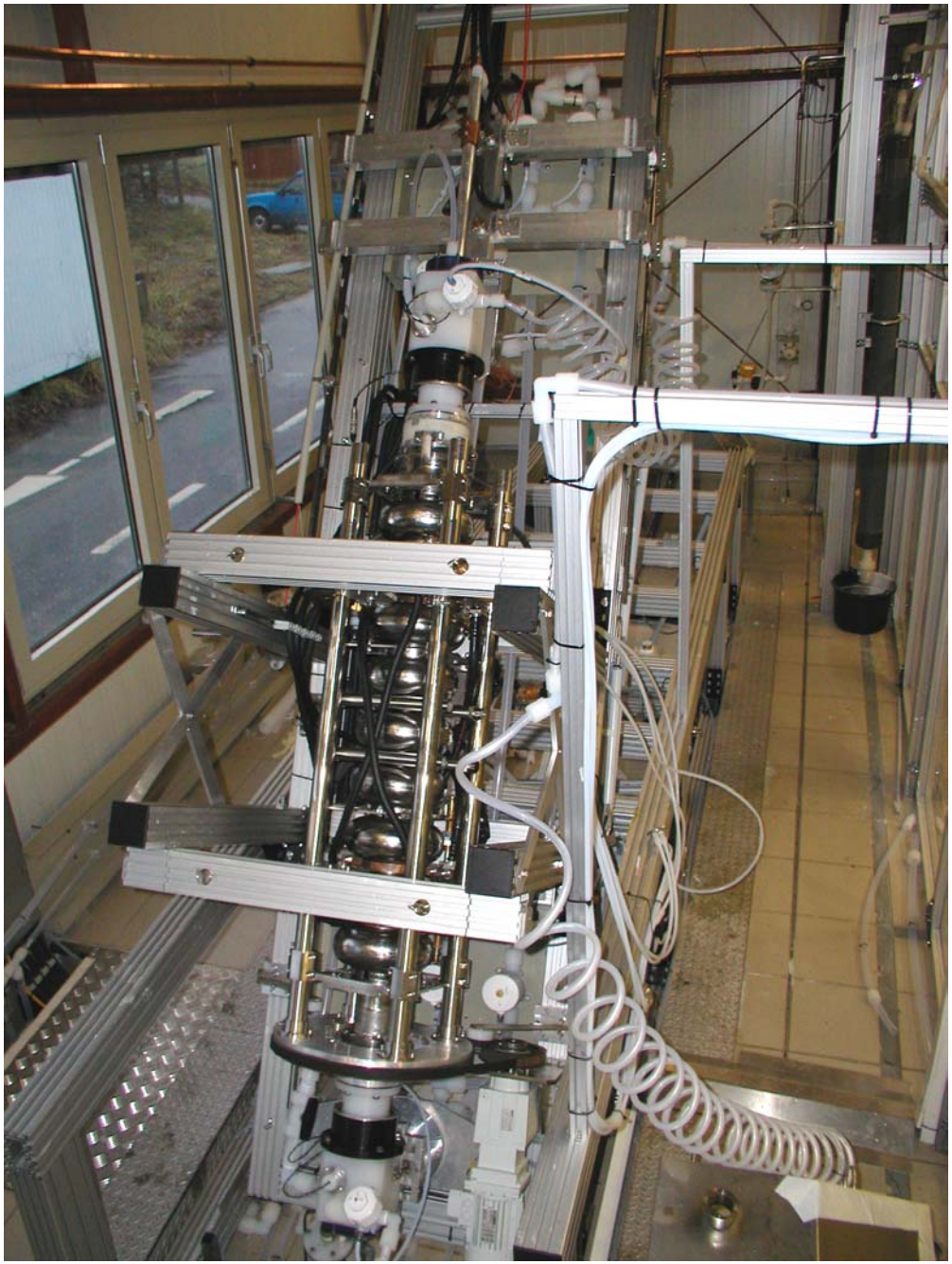
Filling level during EP	~ 55% of volume

Surface covered by acid		190 of 360 deg
➔ active surface	single cell cavity	771 cm2
➔ active surface	nine cell cavity	4655 cm2

Power supply	
Voltage (regulated)	1 – 40 V
Current (regulated)	1- 1500 A







Cavity treatments done at the DESY EP facility in 2003

Cavity	Date	voltage	Eacc before ep	Eacc after EP incl. 120 C heating
1B8	08.04.03	18	28,4	37,9
1S2	22.05.03	18	31,4	40
1B12	04.06.03	18	--	
1B12	17.06.03	18	---	Accident during HP rinse
A14	19.8.03	15	6,38	Test dummy
Ac 78	21.8.03	16	15,4	24
P-1	26.8.03	16	10,5	Q decease
AC 70	7.10.03	17	19	39,5
AC80	06.11.03	17	new	Parameter study
AC 80	12.11.03	17		"
AC80	18.11.03	17		"
P-1	16.10.03	17	10.5	Waiting for restart EP

Removal and field profile

cavity	date	Removed material **Kg**	Removal equator (Rf measure ment) **µm**	Removal iris (Rf measure ment) **µm**	Removal (by weight) **µm**	Field flatnes s **%**	Treat- ment Time **Min**	Voltage **Volt**
A14	20.8.03	0,17	16	23	22	97	60	15
AC 78	21.8.03	0,31	32	62	41	94	180	16
P-1	26.8.03	0,59	43	130	78	90	180	16
AC 70	6.10.03	?	?	?	?	?	120	17
P-1	16.10.03	0,4	35	69	53	93	120	17
AC 80	6.11.03	0,75	86	142	99	81	240	17
AC 80	12.11.03	0,53	52	95	70	90	180	17
AC 80	18.11.03	0,32	35	59	42	93	120	17

Example of field flatness change

MODE SPECTRUM MEASURED ON TUNING MACHINE

Cavity AC80 **Measured on 06-Nov-2003 14:35** **Field Flatness [%]: 80**

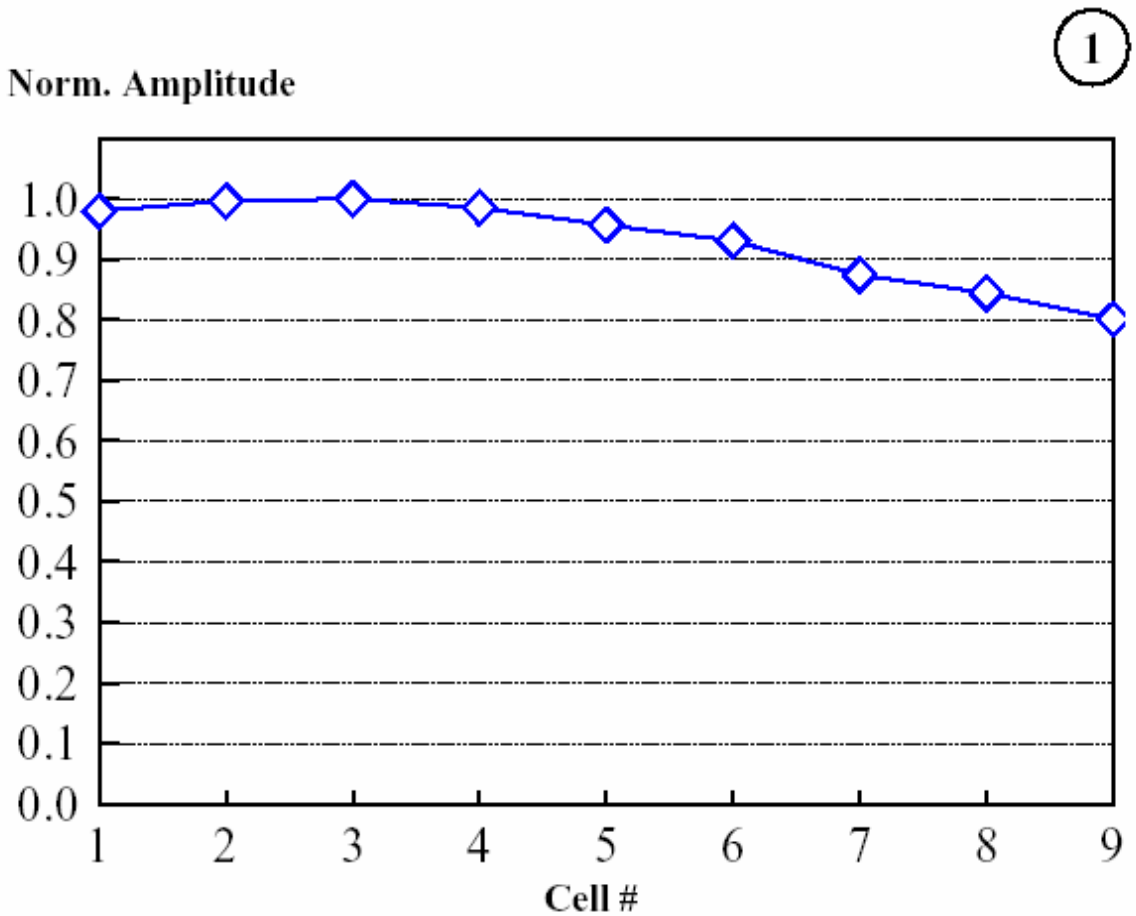
Remark: without tube

120 Min

Measurement Mode: **Pi**

Mode Frequency: **1298089000**

Cell #	Amplitude	Norm. Amplitude
1	135.142	.98
2	-137.4447	-1
3	137.9482	1
4	-135.9057	-.99
5	131.966	.96
6	-128.3772	-.93
7	120.6291	.87
8	-116.4476	-.84
9	110.5428	.8



MODE SPECTRUM MEASURED ON TUNING MACHINE

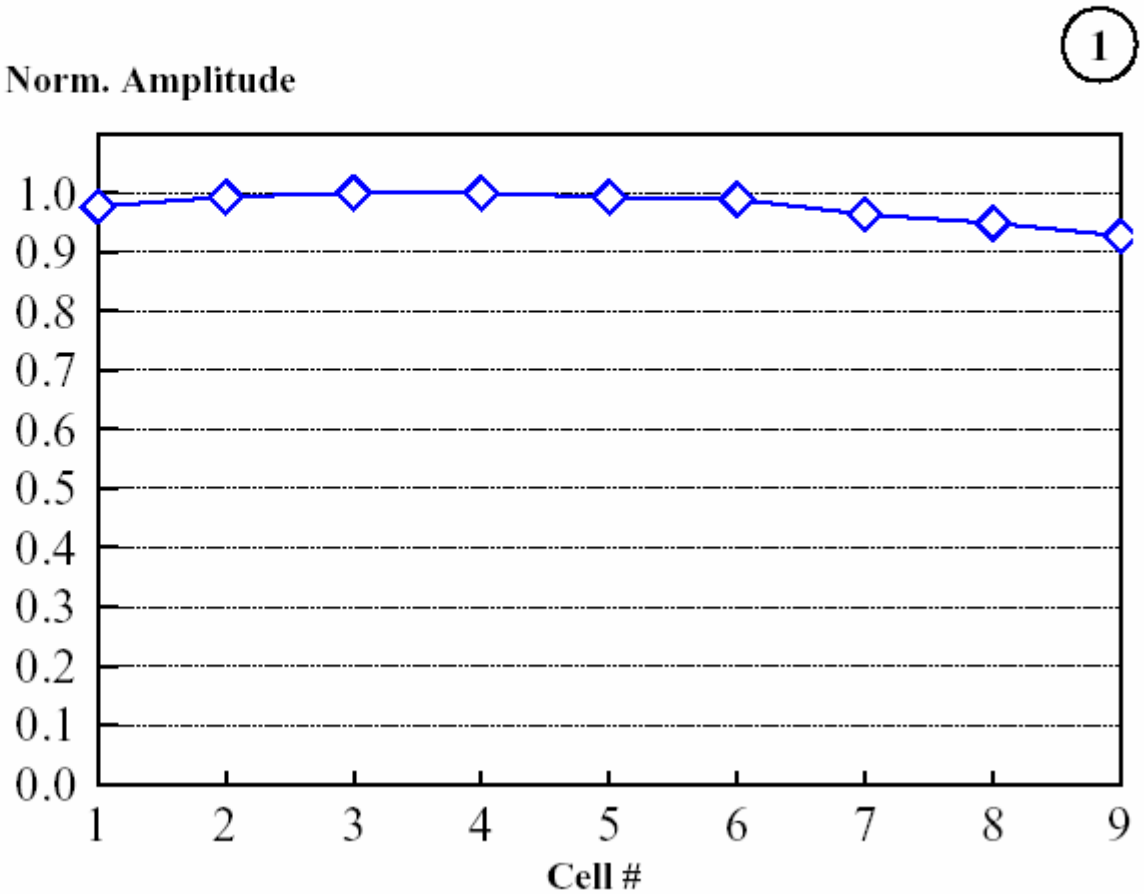
Cavity AC80 **Measured on 18-Nov-2003 12:08** **Field Flatness [%]: 93**

Remark: without tube 120 Min

Measurement Mode: **Pi**

Mode Frequency: **1297577000**

Cell #	Amplitude	Norm. Amplitude
1	128.8546	.98
2	-130.9845	-.99
3	131.9219	1
4	-131.8478	-1
5	130.9782	.99
6	-130.4558	-.99
7	127.0833	.96
8	-125.1464	-.95
9	122.2745	.93



MODE SPECTRUM MEASURED ON TUNING MACHINE

Cavity AC80 **Measured on 12-Nov-2003 14:18** **Field Flatness [%]: 89**

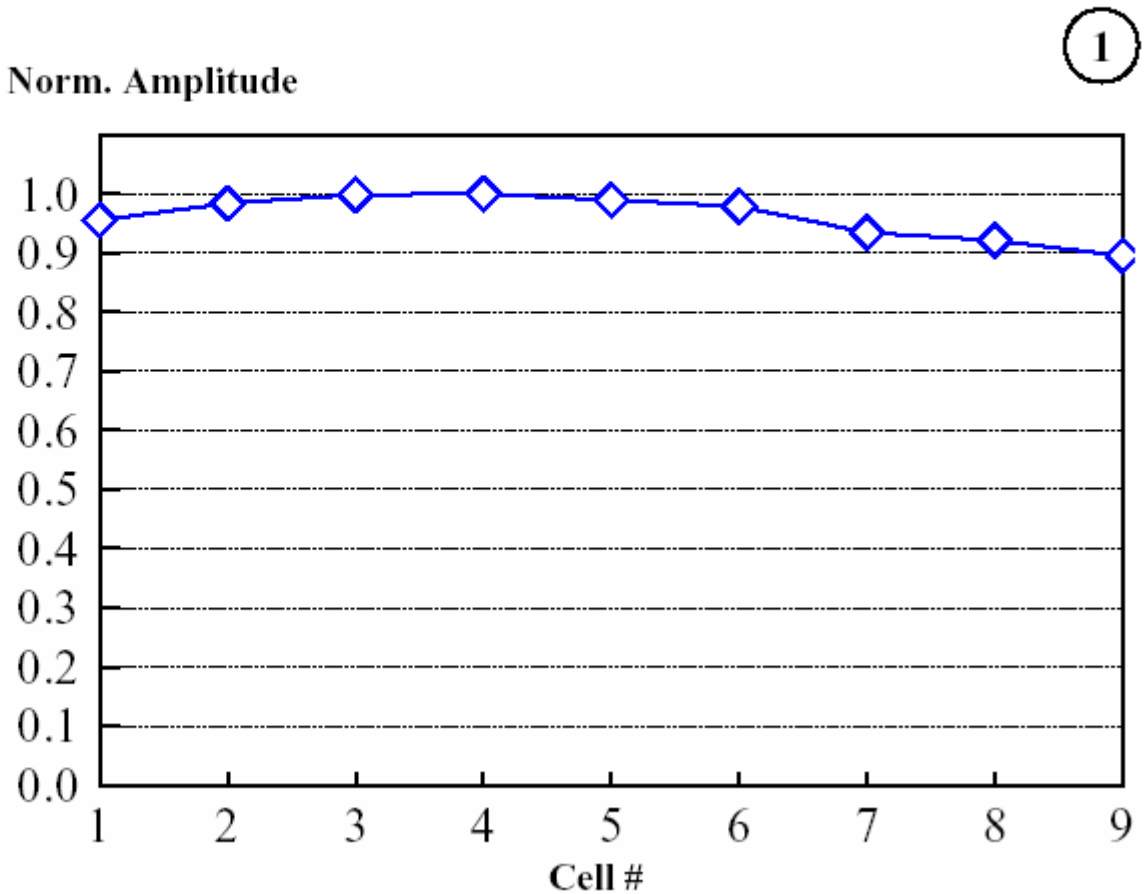
Remark: without tube

180 min

Measurement Mode: **Pi**

Mode Frequency: **1297768000**

Cell #	Amplitude	Norm. Amplitude
1	128.0104	.96
2	-131.8054	-.99
3	133.741	1
4	-133.9876	-1
5	132.5355	.99
6	-131.1132	-.98
7	125.1865	.94
8	-123.3964	-.92
9	119.9111	.9



MODE SPECTRUM MEASURED ON TUNING MACHINE

Cavity AC80 **Measured on 06-Nov-2003 14:35** **Field Flatness [%]: 80**

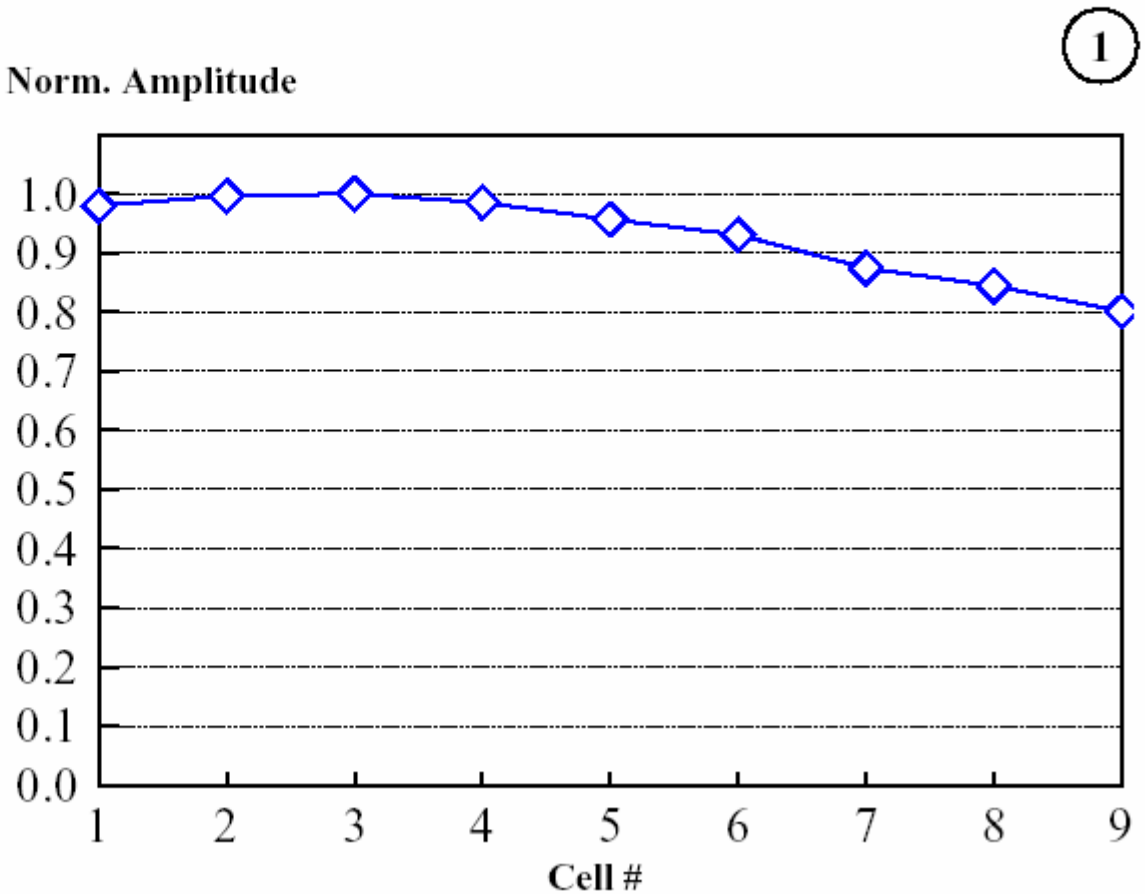
Remark: without tube

240 min

Measurement Mode: **Pi**

Mode Frequency: **1298089000**

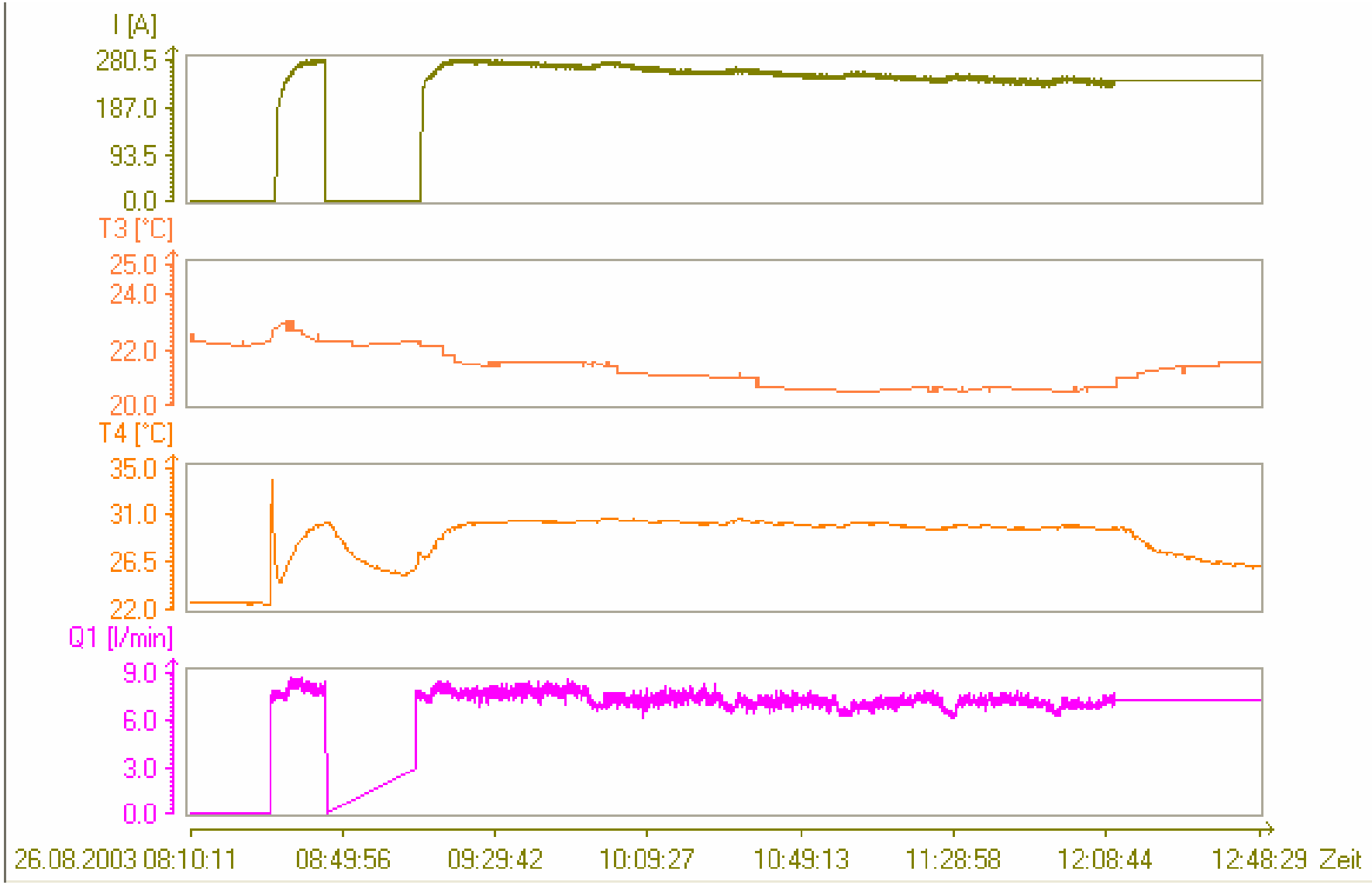
Cell #	Amplitude	Norm. Amplitude
1	135.142	.98
2	-137.4447	-1
3	137.9482	1
4	-135.9057	-.99
5	131.966	.96
6	-128.3772	-.93
7	120.6291	.87
8	-116.4476	-.84
9	110.5428	.8



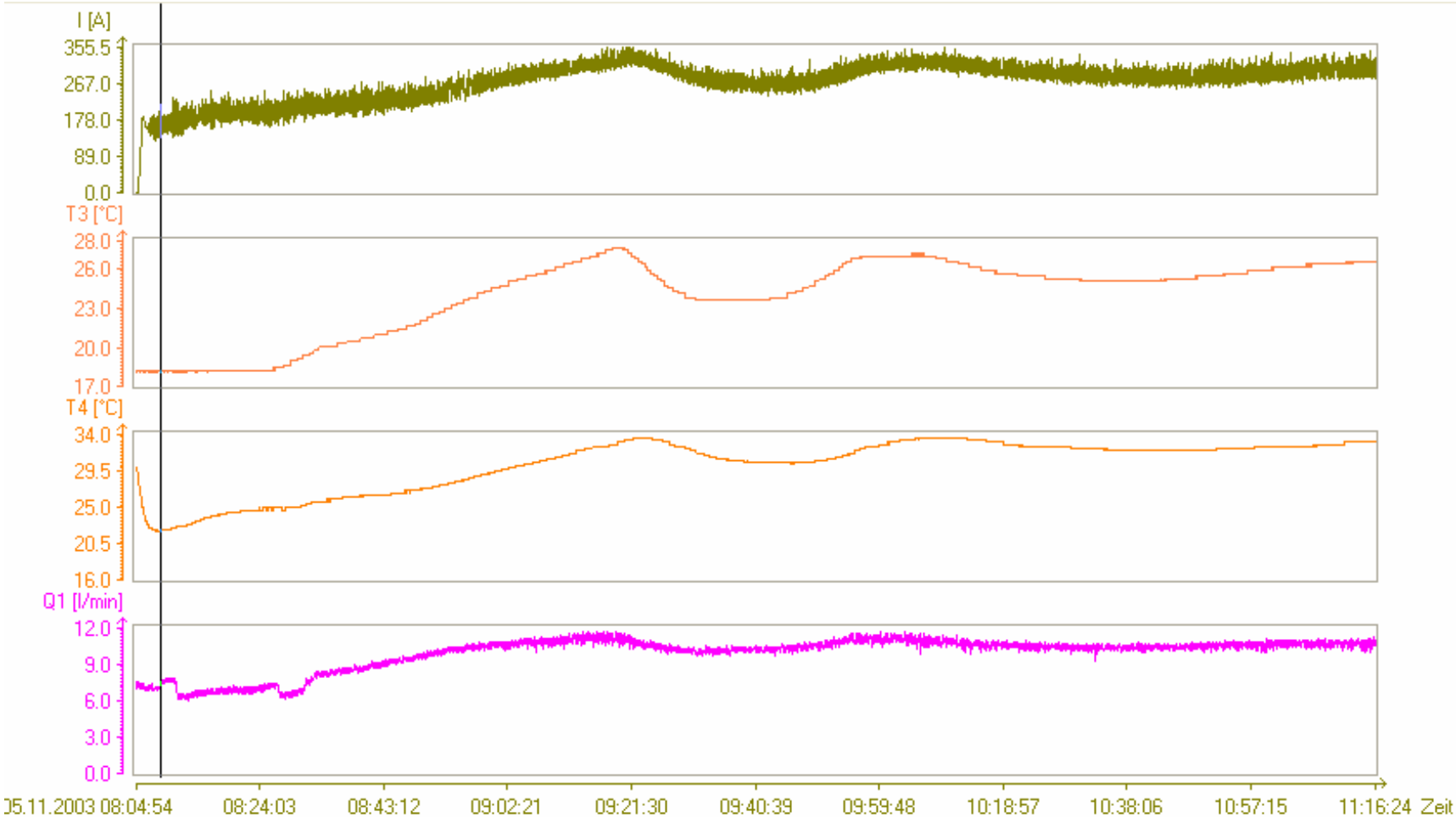
Data

Cavity	Voltage V	Current density A/dm^2	Removal rate µm /min	Average temperature C
1B8	18	4,7	??	20,1
1S2	18	4	??	24,15
1B12	18	6,6	??	29,2
1B12	18	5,7	??	26,95
A14	15	4,71	0,37	
AC78	16	5,38	0,23	31
P-1	16	4,95	0,43	30
AC70	17	5,59	??	29
P-1	17	5,98	0,44	29,8
AC80	17	5,96	0,41	30,9
AC80	17	5,31	0,39	28,6
AC80	17	4,95	0,35	28,1

EP data of cavity
P-1 26.8.03



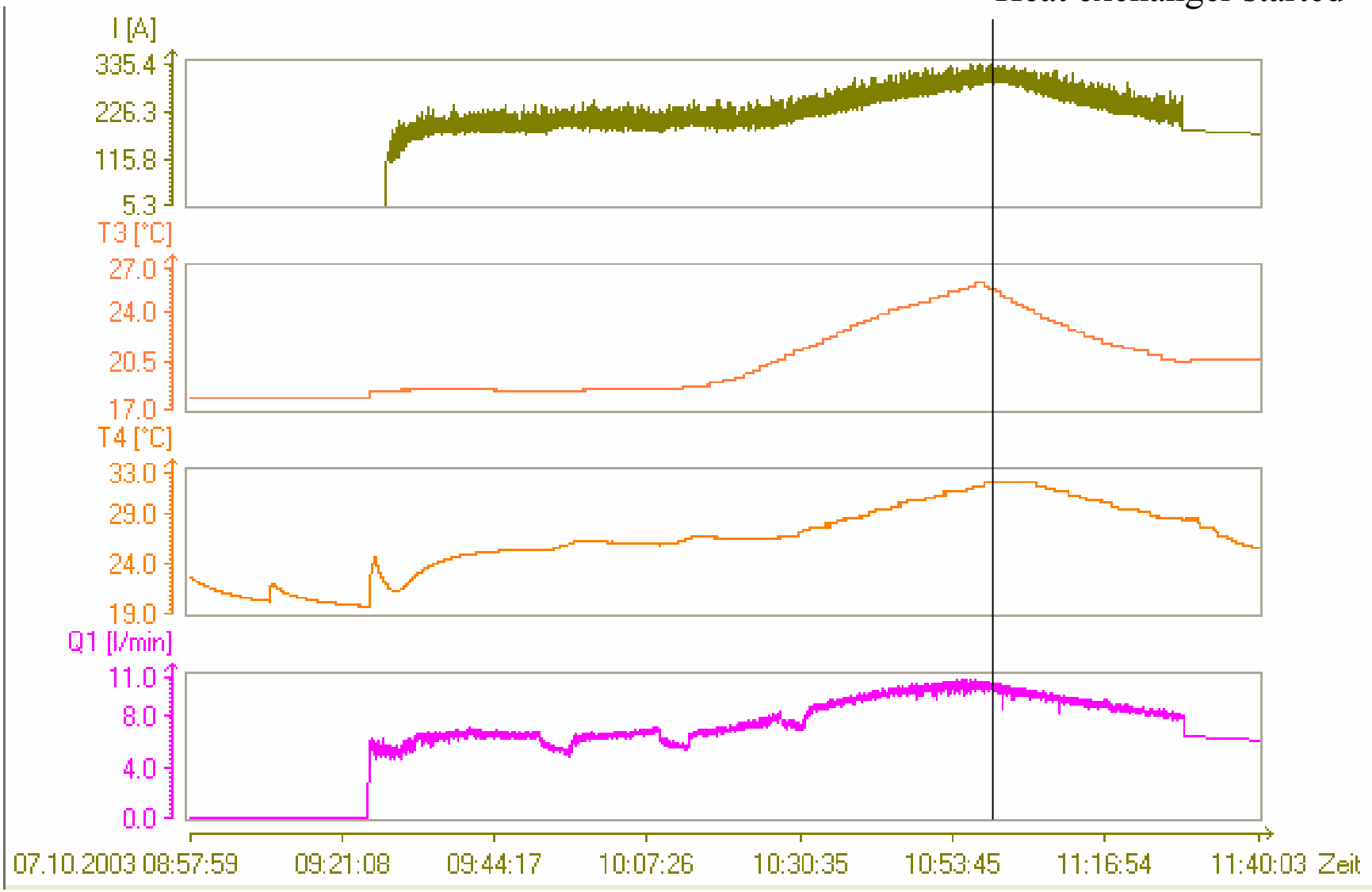
EP data of cavity
AC 80 5.11.03



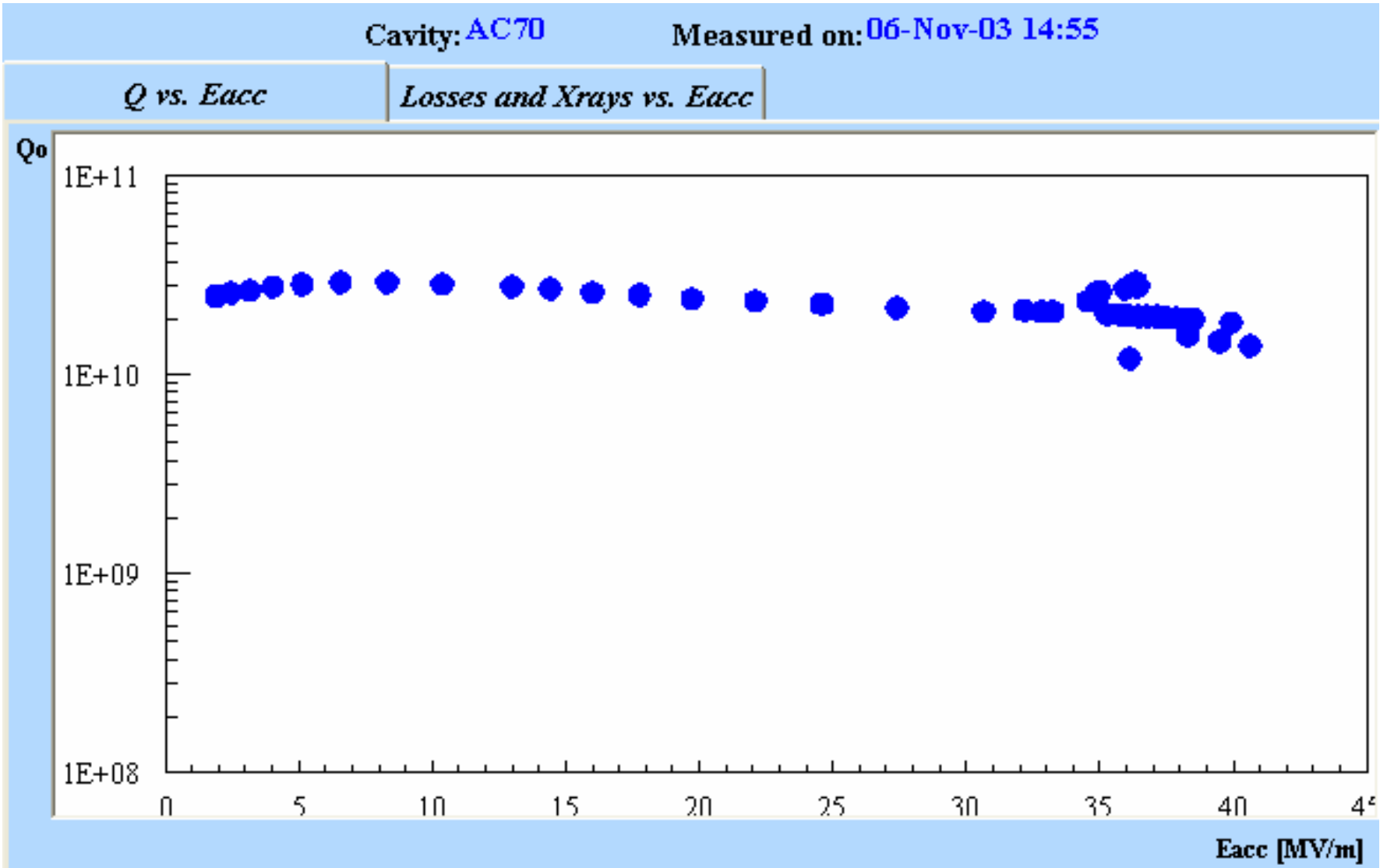
Prozesswerte

Kurve	Variablenanbindung	Wert	Datum/Zeit
Strom	Netzteilwerte\Strom	216.58	05.11.2003 08:08:38.870
T3: WT 1 Ablauf	Temperatur\T3_Waermetauscher1_Ablauf	18.3	05.11.2003 08:08:38.870
T4: WT 2 Zulauf	Temperatur\T4_Warmetauscher2_Zulauf	22.1	05.11.2003 08:08:38.870
Q1: Säuredurchfluss	Durchfluss\Q1_Saeuredurchfluss	7.35	05.11.2003 08:08:38.870

EP data of cavity
AC 70 7.10.03

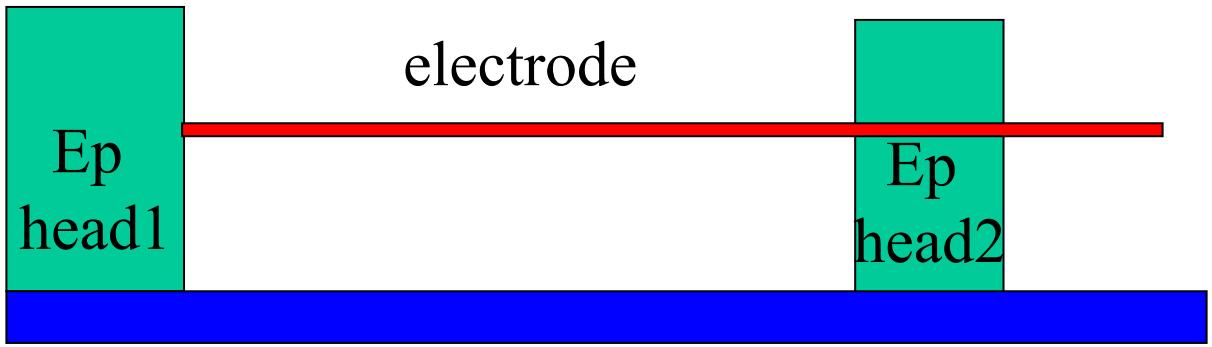


Test result of AC 70



AC 70 recovered from 19 MV/m to 39.5 MV/m after EP at DESY

Assembly / dismount cavity on EP bench



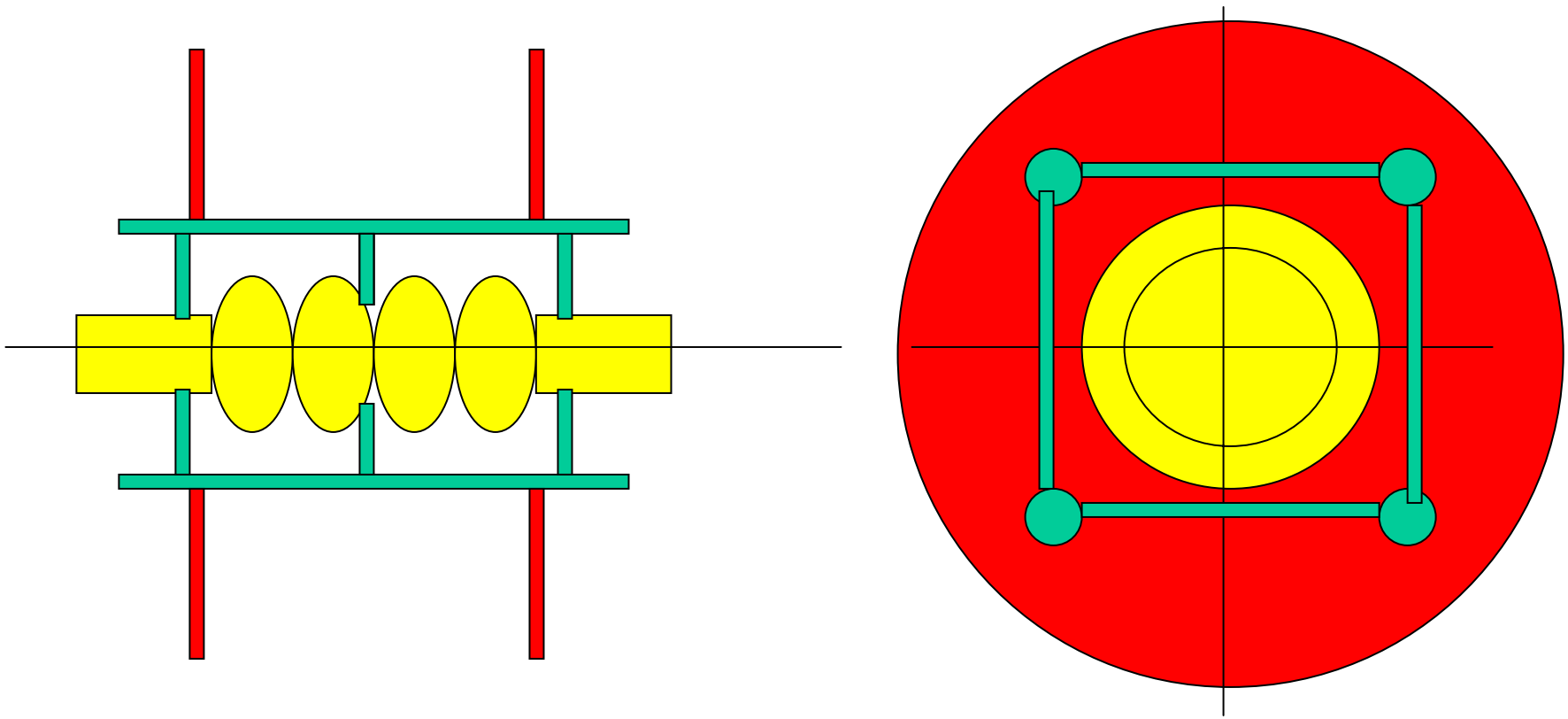
Fixed geometry of ep bench

Heat and acid distribution needs head 1+2 in horizontal plane
Electrode has always to be covered by acid (safety !!)
For regular material removal

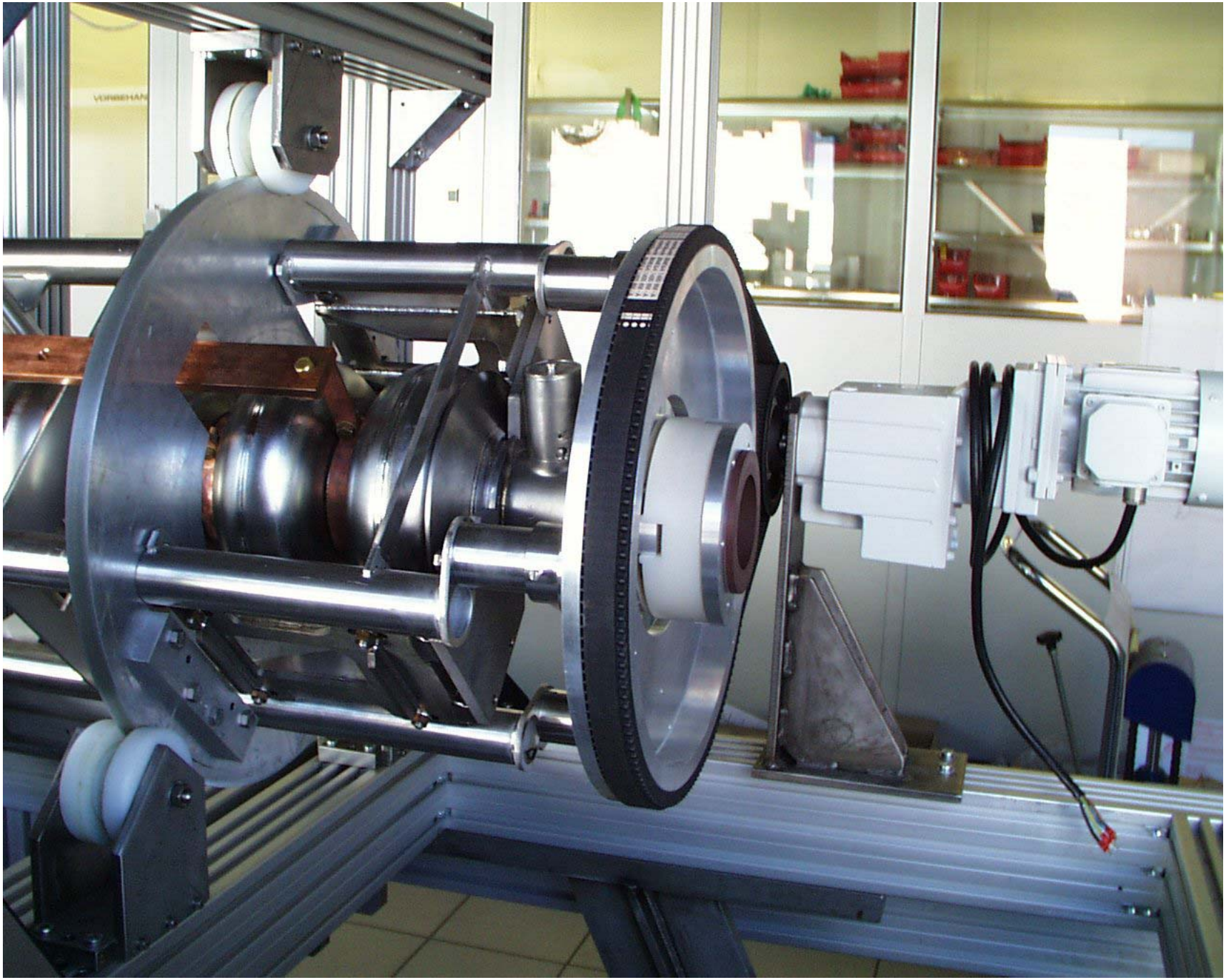
a constant distance of electrode to cavity surface is required

Consequence
Cavity has to be tuned to geometrical axis
Cavity has to be aligned to electrode axis
Electrode has to be horizontal
Cavity has to be aligned to frame axis

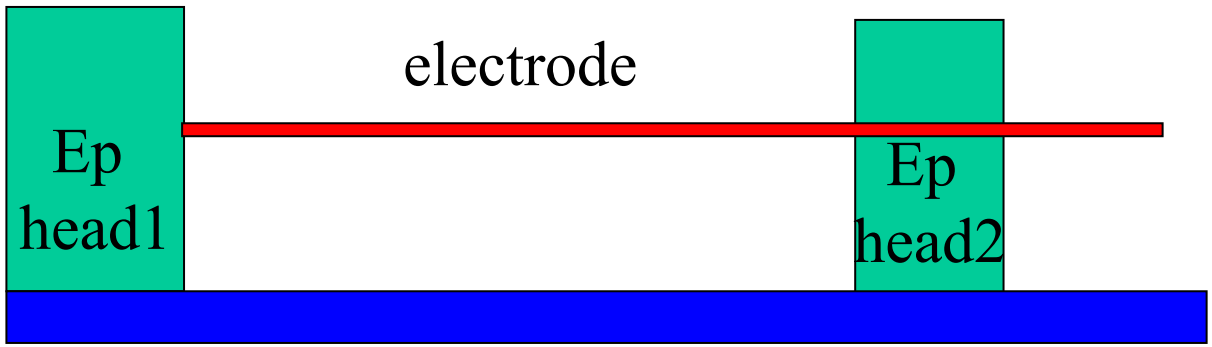
Alignment of cavity frame and Current transfer disc to bench



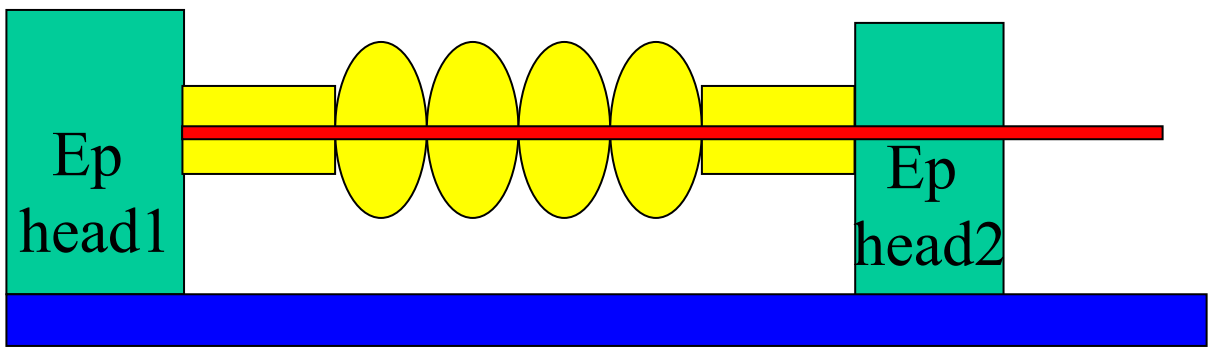
Precision of alignment +- 2 mm Cavity axis to disc axis

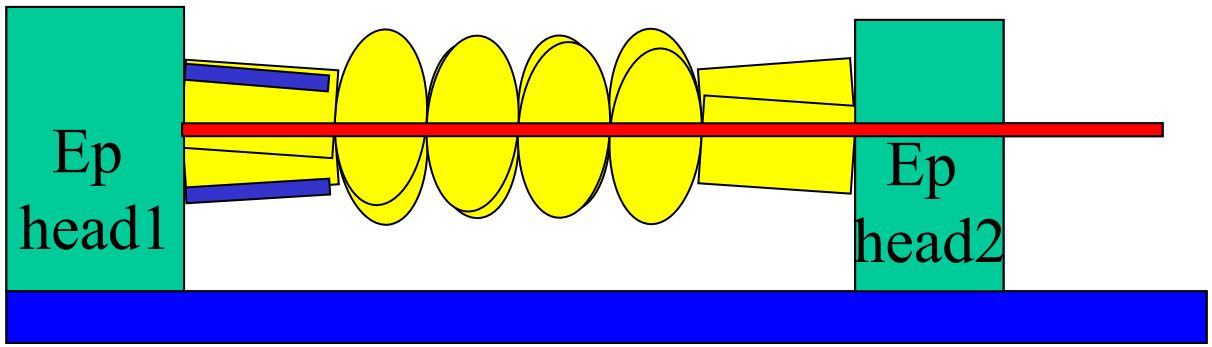


Data of alignment

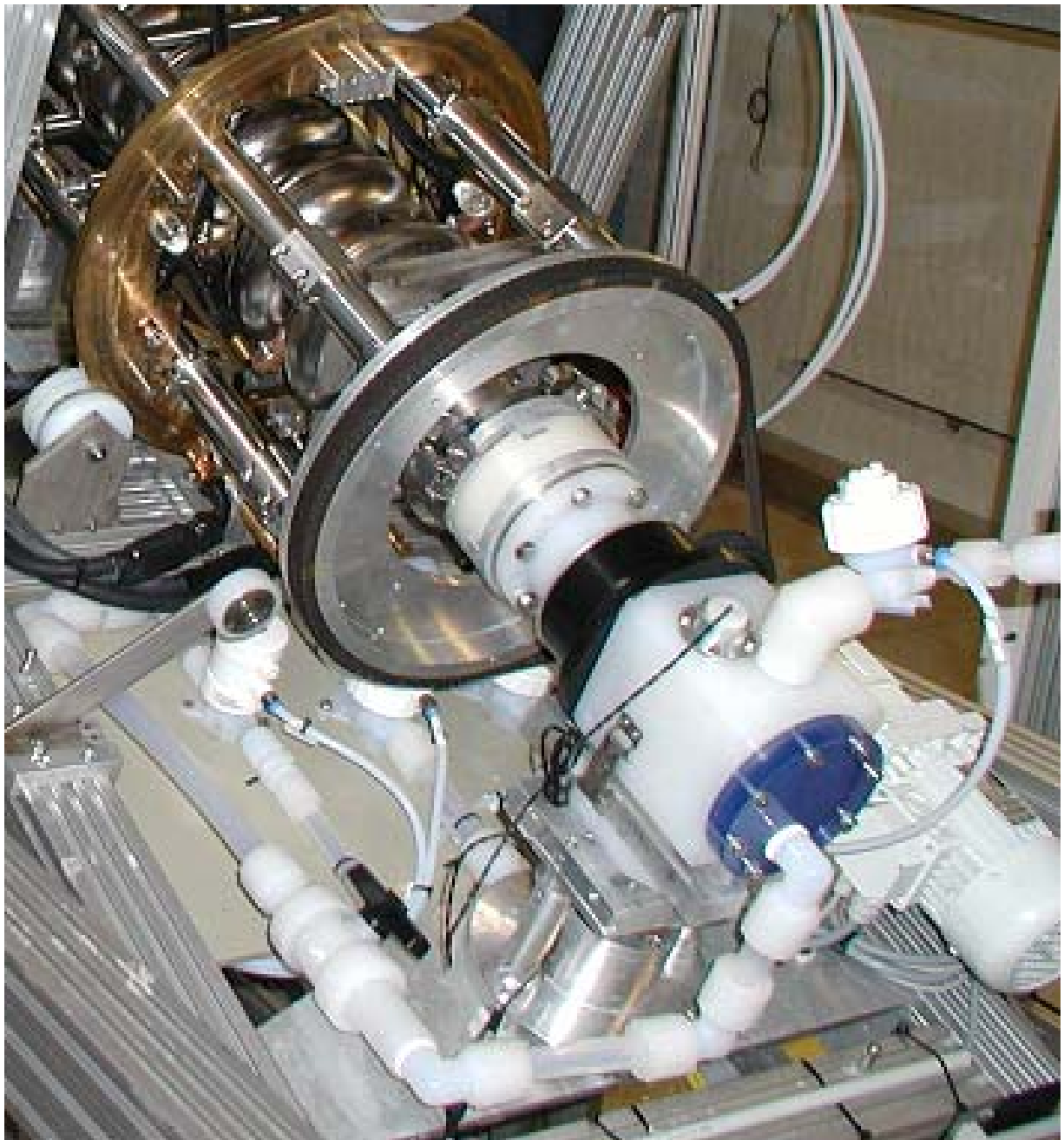


Reproducibility of electrode axis +-1mm on 1.5 m





Actually alignment and installation takes about 1 day
(Cavity to frame/ frame to disc/ disc to bench)
and leaktest last for 2 days



Demounting sequence

BCP

Rinse inside BCP stand	(40 Min)
Dismount from BCP stand	(5 Min)
Change flanges	(15 Min)
Rinse to 18Mohm cm	(30 Min)
Dismount flanges	(1 Min)
Total time	1h 31 Min

1st HP rinse

EP

Rinse inside Ep stand	(2 h)
Dismount from Ep stand	(1 h)
Clean outside by car wash / ultra sound	(1 h)
Demount EP head / driving ring	(30 Min)
change flanges	(15 Min)
Rinse to 18 Mohm cm	(30 Min)
Demount flanges	(1Min)
Total time	5h 16 Min

1st HR rinse

Conclusion after start up of the DESY Ep

INFRASTRUCTURE

Ep + 6 times HP rinse showed very low field emission at high gradients

Removal rate between 0.35 and 0.45 µm/min

2 times higher removal on iris than on equator ←

Field profile seems to be tilted by 0.5 to 0.6 % per 10 Minutes ←

Field profile tilt seems to have one major direction (cell 1) ←

EP shows strong dependency on current and acid temperature

Warm up of acid take 1 h (180 l) (bad for short treatments) ←

PROCESS

Ep process parameters seem to be in the right range for high gradients

It looks like a wide range of parameters are acceptable (15-18V)

Ep facility infrastructure seems to be reliable

Assembly of cavity to Ep stand very time consuming ←

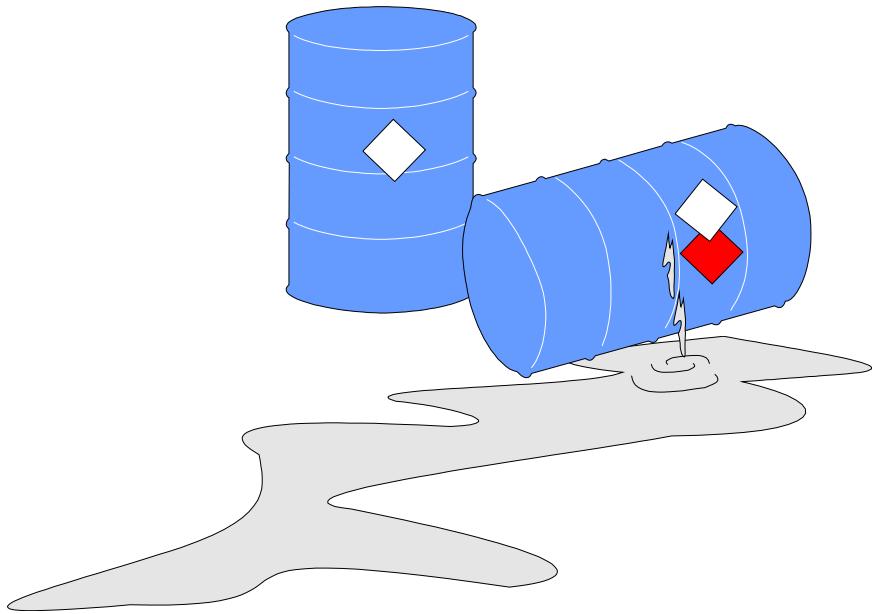
Time between Ep and first HP rinse longer than after BCP ←

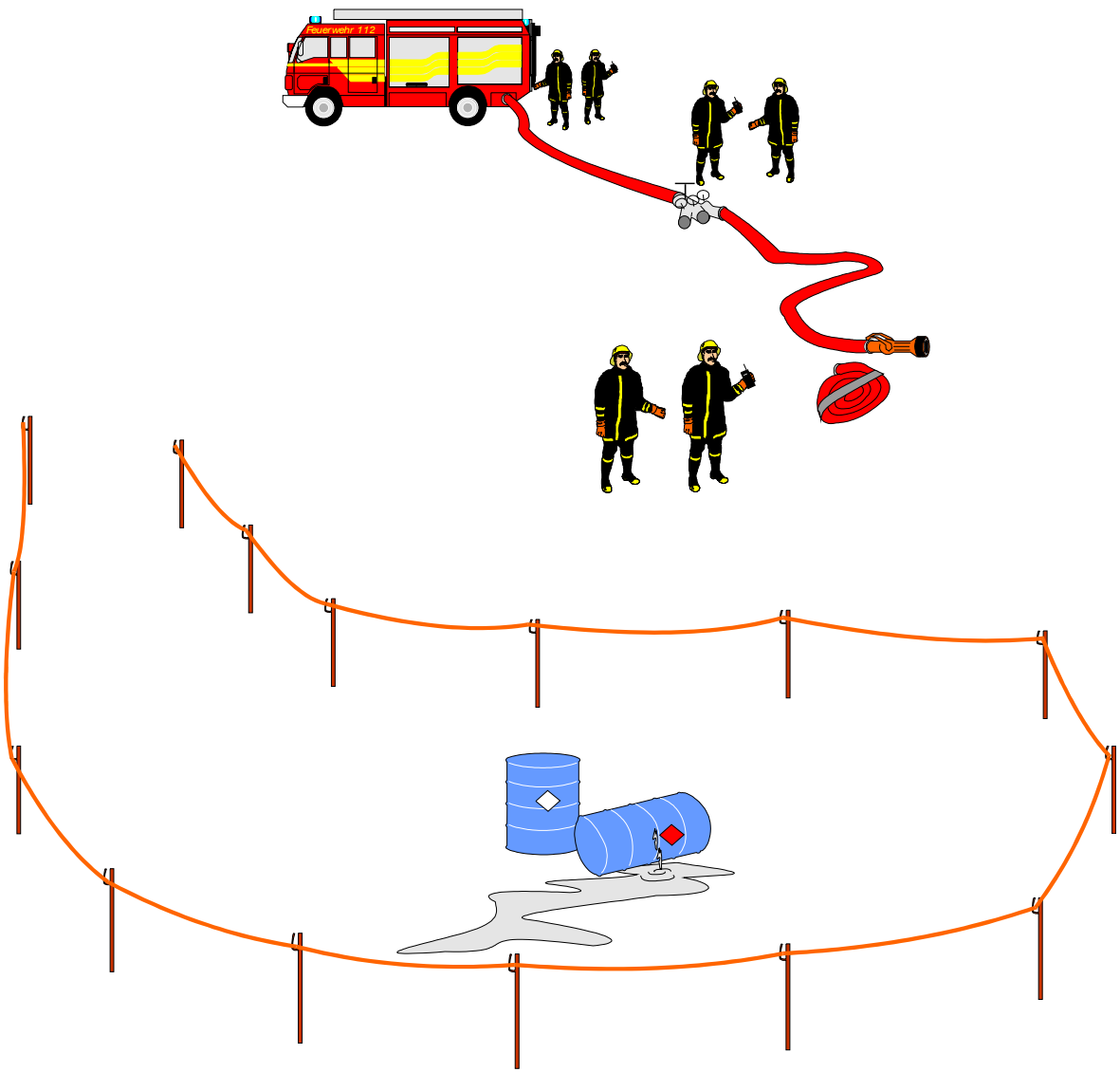
Up to 10gr Niobium /l acid no reduction of removal rate was seen

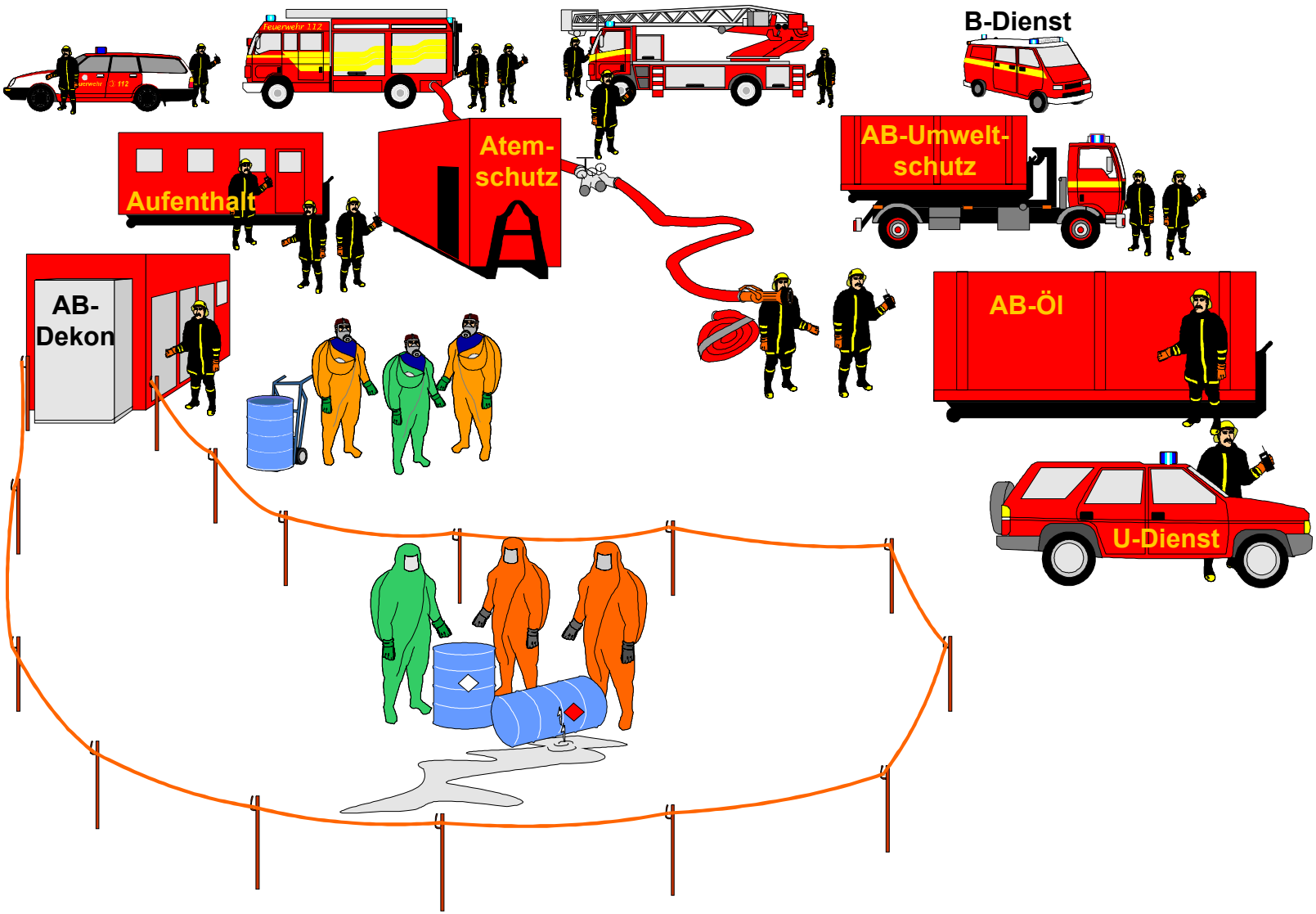
What did we do since October 03

We have had some experiences not correlated to our research

We had a problem with one of the ep acid vessels




Feuerwehr 112


B-Dienst
Aufenthalt
Atem-
schutz
AB-Umwelt-
schutz
AB-
Dekon
AB-Öl
U-Dienst


SCANIA
93M
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UMWELT - DIENST
FEUERWEHR HAMBURG