Drift Tube Quality Control
Muon week – CERN – 3rd April 2002

- **QC results overview**
- **QC at Production Sites:**
  - **Aachen Thomas/Kerstin**
- **Definition of Noise QC test and QC tests with Cosmics**
- **Procedure to Quality control the QC tests**

Chamber QC Overview Results

- **First overview of results on QC tests for SL and Chambers in term**

  an Excel table and summary plots.

http://www.to.infn.it/activities/experiments/cms/SLQC/SLQC.html

- **Detailed procedures of QC tests in each production site**

Outcome of the result overview:

Each QC test must have:

Average acceptance limits (tolerances in QC book)

Extreme acceptance limits

Super Layers and Chambers Quality Control Tests in the QC Book

QC test	Specifics & general Procedure	Detailed Procedure at Production Site	Tolerance	Rejection Limits
Wire position	ok		ok	
First I-beam position	ok		ok	
First strip position	ok		ok	
Cathodes HV contacts	ok		ok	
-Strips HV contacts	ok		ok	
-Wire tension	ok		ok	
Ref block position	improve		ok	
-Gas tightness	ok		ok	
-Gas purity	ok		ok	
HV test	ok		ok	
SL thickness	improve		ok	
HoneyComb panel planarity	ok		ok	
-Noise	miss		miss	
SL alignment inside chamber	improve		ok	
-SL tilt inside chamber	improve		ok	
Chamber thickness	improve		ok	
-Cosmics	miss		miss	

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CMS Drift TubesQuality Control Tests Results
--- Table 1 ---

Last update: 21st March 2002

Please note *Negative numbers have the following meaning:*

-500 = The quantity has been measured and is within QC tolerance but measures not sent

-1000 = Hardware/software for the QC test in progress

-1500 = Hardware/software OK, but quantity not yet measured OR no information sent

SL Produced	Chamber Produced	Production Sites	Wire Position	Wire Tension	HV test in air	Gas Tightness	Gas Purity	HV test in gas	SL noise	Cosmics
SL001phi	1	Aachen	-500	-500	0	140 (140)	-1000	0	-	-
SL002th			-500	-500	0	670 (1100)	-1000	0	-	-
SL003phi			-500	-500	0	260 (280)	-1000	0	-	-
SL004phi			-500	-500	0	(3000)	-1000	-1500	-	-

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SL Produced	Chamber Produced	Production Sites	Wire Position	Wire Tension	HV test in air	Gas Tightness	Gas Purity	HV test in gas	SL noise	Cosmics
SL004phi	2	Aachen	-500	-500	0	(3000)	-1000	-1500	-	-
SL005th			-500	-500	10	(>3000)	-1000	-1500	-	-
SL006phi			-500	-500	1	(>3000)	-1000	-1500	-	-
SL007phi	-	Aachen	-500	-500	0	1200 (1800)	-1000	2	-	-
SL008phi(I)	-	Aachen	-500	-500	-1500	(1200)	-1000	-1500	-	-
SL009th	-	Aachen	-500	-500	0	(280)	-1000	1	-	-
SL010phi	-	Aachen	-500	-500	-1500	(1000)	-1000	-1500	-	-
SL011phi(I)	-	Aachen	-500	-500	0	(1200)	-1000	0	-	-
SL012th	-	Aachen	-500	-500	0	(>3000)	-1000	1	-	-
SL013phi	-	Aachen	-500	-500	0	(1100)	-1000	2	-	-
SL014th	-	Aachen	-500	-500	0	(600)	-1000	1	-	-
SL015phi(I)	-	Aachen	-500	-500	0	230 (2200)	-1000	0	-	-
SL016phi	-	Aachen	-500	-500	0	(440)	-1000	-1500	-	-
SL017th	-	Aachen	-500	-500	-1500	(180)	-1000	-1500	-	-
SL018phi(I)	-	Aachen	-500	-500	-1500	(400)	-1000	-1500	-	-
SL019phi	-	Aachen	-500	-500	-1500	(2000)	-1000	-1500	-	-
SL020th	-	Aachen	-500	-500	-1500	-1500	-1000	-1500	-	-

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SL Produced	Chamber Produced	Production Sites	Wire Position	Wire Tension	HV test in air	Gas Tightness	Gas Purity	HV test in gas	SL noise	Cosmics
ph1	MB2_001	Madrid	-500	-500	-500	-1500	-1500	-500	-	-
theta			-500	-500	-500	-1500	-1500	-500	-	-
phi2			-500	-500	-500	-1500	-1500	-500	-	-
phi1	MB2_002	Madrid	-500	-500	-500	-1500	320	8	-	-
theta			-500	-500	-500	-1500	125		-	-
phi2			-500	-500	-500	-1500	200		-	-
phi1	MB2_003	Madrid	-500	-500	-500	125 to 250	<250	2 (5?)	-	-
theta			-500	-500	-500	277 to 166	<250		-	-
phi2			-500	-500	-500	635 to 93	<250		-	-
phi1	MB2_004	Madrid	-500	-500	-500	40to 38	<100	3	-	-
theta			-500	-500	-500	50 to 61	<100		-	-
phi2			-500	-500	-500	25 to 91	<100		-	-
phi1	MB2_005	Madrid	-500	-500	-500	20to 592	100	8 (10?)	-	-
theta			-500	-500	-500	50 to 64	200		-	-
phi2			-500	-500	-500	70 to 192	<100		-	-
phi1	MB2_006	Madrid	-500	-500	-500	115	100	4	-	-
theta			-500	-500	-500	150	180		-	-

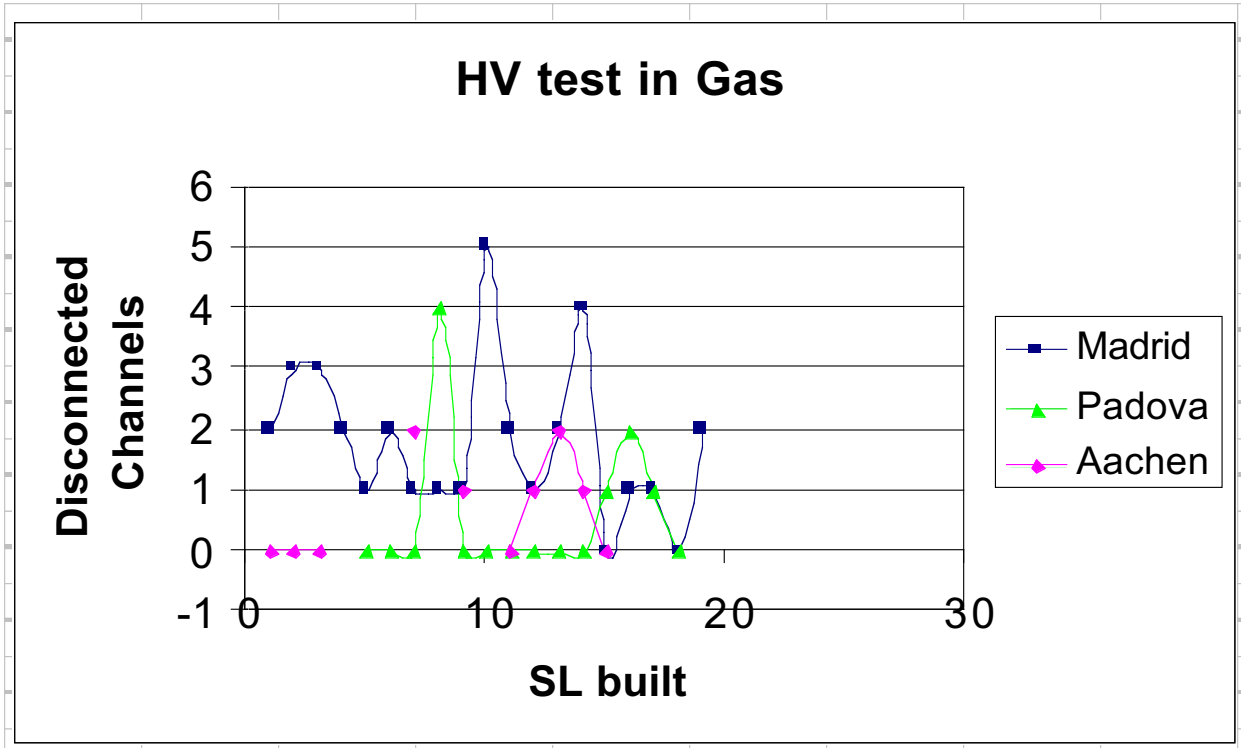
Drift Tube Quality Control (meeting)

SL Produced	Chamber Produced	Production Sites	Wire Position	Wire Tension	HV test in air	Gas Tightness	Gas Purity	HV test in gas	SL noise	Cosmics
phi1	MB2_006	Madrid	-500	-500	-500	115	100	4	-	-
theta			-500	-500	-500	150	180		-	-
phi2			-500	-500	-500	800	90		-	-
phi1	MB2_007	Madrid	-500	-500	-500	3000	<55	2	-	-
theta			-500	-500	-500	58	<55		-	-
phi2			-500	-500	-500	350	<55		-	-
phi1	MB2_008	Madrid	-500	-500	-500	280	<80	3	-	-
theta			-500	-500	-500	2300	<80		-	-
phi2			-500	-500	-500	infinity	<80		-	-
phi1	MB2_009	Madrid	-500	-500	-500	500	-1500	1	-	-
theta			-500	-500	-500	150	-1500		-	-
phi2			-500	-500	-500	525	-1500		-	-
phi1	MB2_010	Madrid	-500	-500	-500	-1500	-1500	-1500	-	-
theta			-500	-500	-500	-1500	-1500	-1500	-	-
phi2			-500	-500	-500	-1500	-1500	-1500	-	-
phi1	MB2_011	Madrid	-500	-500	-500	-1500	-1500	-1500	-	-
theta			-500	-500	-500	-1500	-1500	-1500	-	-
phi2			-500	-500	-500	-1500	-1500	-1500	-	-

….an extract of the overview result table…

SL Produced	Chamber Produced	Production Sites	Wire Position	Wire Tension	HV test in air	Gas Tightness	Gas Purity	HV test in gas	SL noise	Cosmics
SLph1_002	MB3_001	Padova	38.5	-500	-500	infinity	-500	0	0 (0)	-
SLph1_003			46.4	-500	-500	infinity	-500	0	0 (0)	-
SLth_001			36.4	-500	-500	infinity	-500	0	2 (1)	-
SLph1_004	MB3_002	Padova	34.1	-500	-500	960	-500	4	0 (0)	-
SLph1_005			38.6	-500	-500	infinity	-500	0	1 (0)	-
SLth_002			31.6	-500	-500	infinity	-500	0	2 (0)	-
SLph1_006	MB3_003	Padova	42.6	-500	-500	infinity	-500	0	3 (1)	-
SLph1_007			36.5	-500	-500	infinity	-500	0	12 (5)	-
SLth_003			35	-500	-500	infinity	-500	0	0 (0)	-
SLph1_008	MB3_004	Padova	37.8	-500	-500	infinity	-500	0	22 (7)	-
SLth_004			39	-500	-500	infinity	-500	1	9 (2)	-
SLph2_009			42	-500	-500	infinity	-500	2	0 (0)	-
SLph1_010	MB3_005	Padova	26.8	-500	-500	infinity	-500	1	15 (6)	-
SLth_005			35.3	-500	-500	infinity	-500	0	2 (0)	-
SLph_011			33.1	-500	-500	-500	-500	-500	-500	-

Drift Tube Quality Control (meeting)



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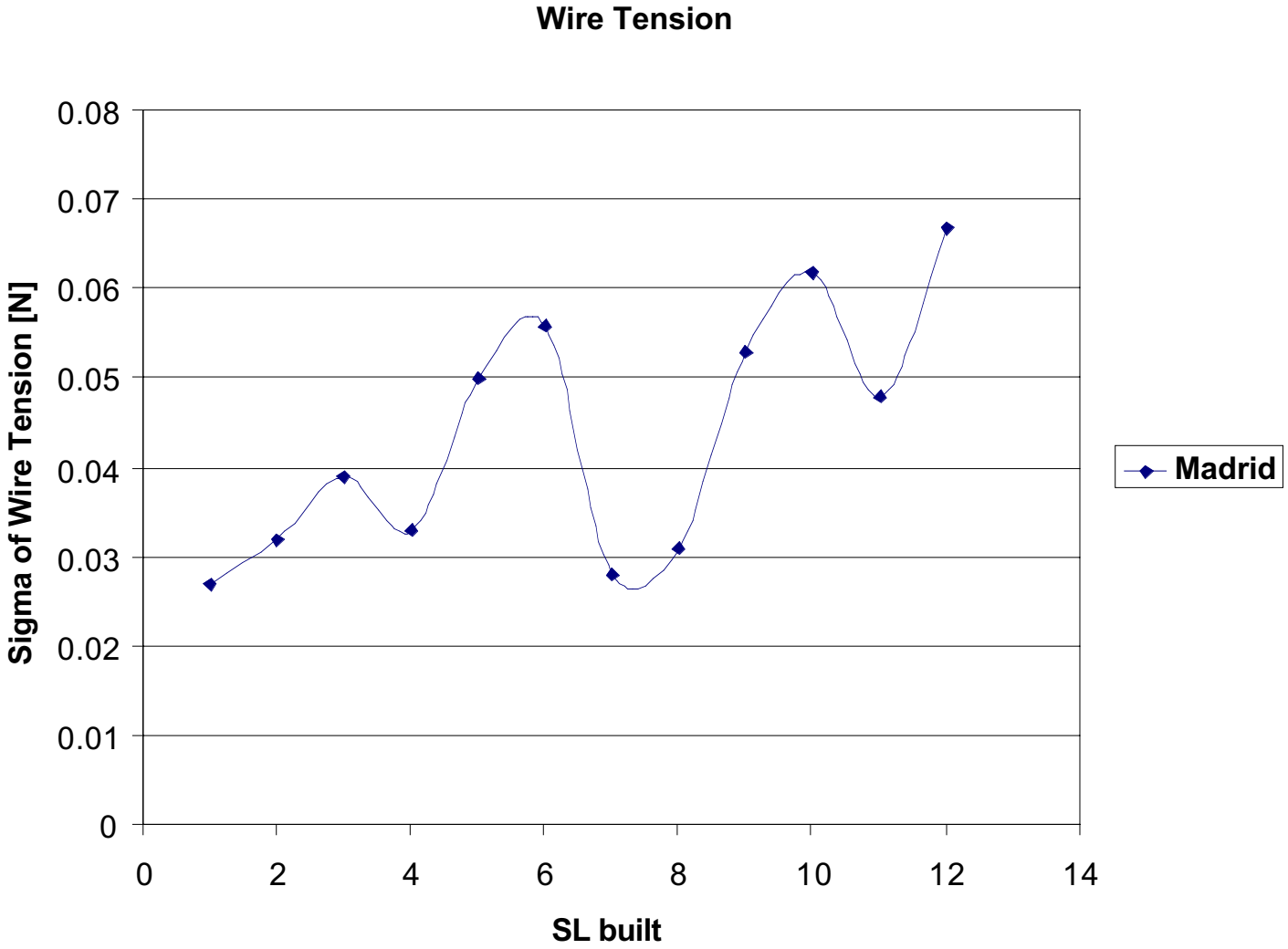

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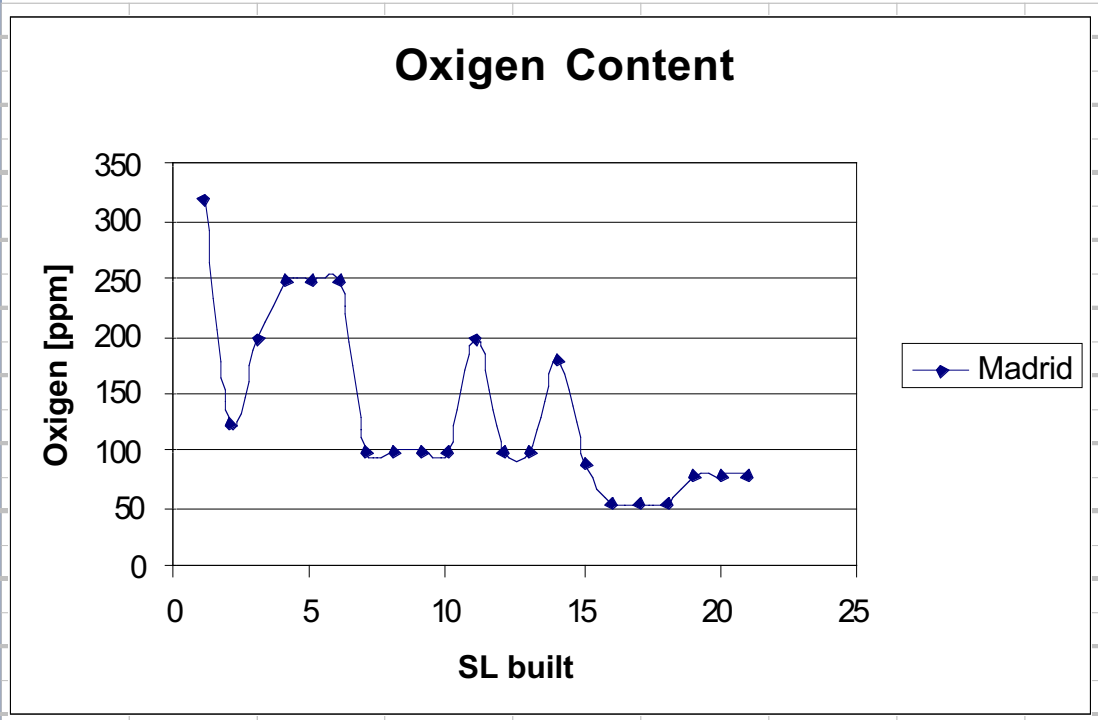

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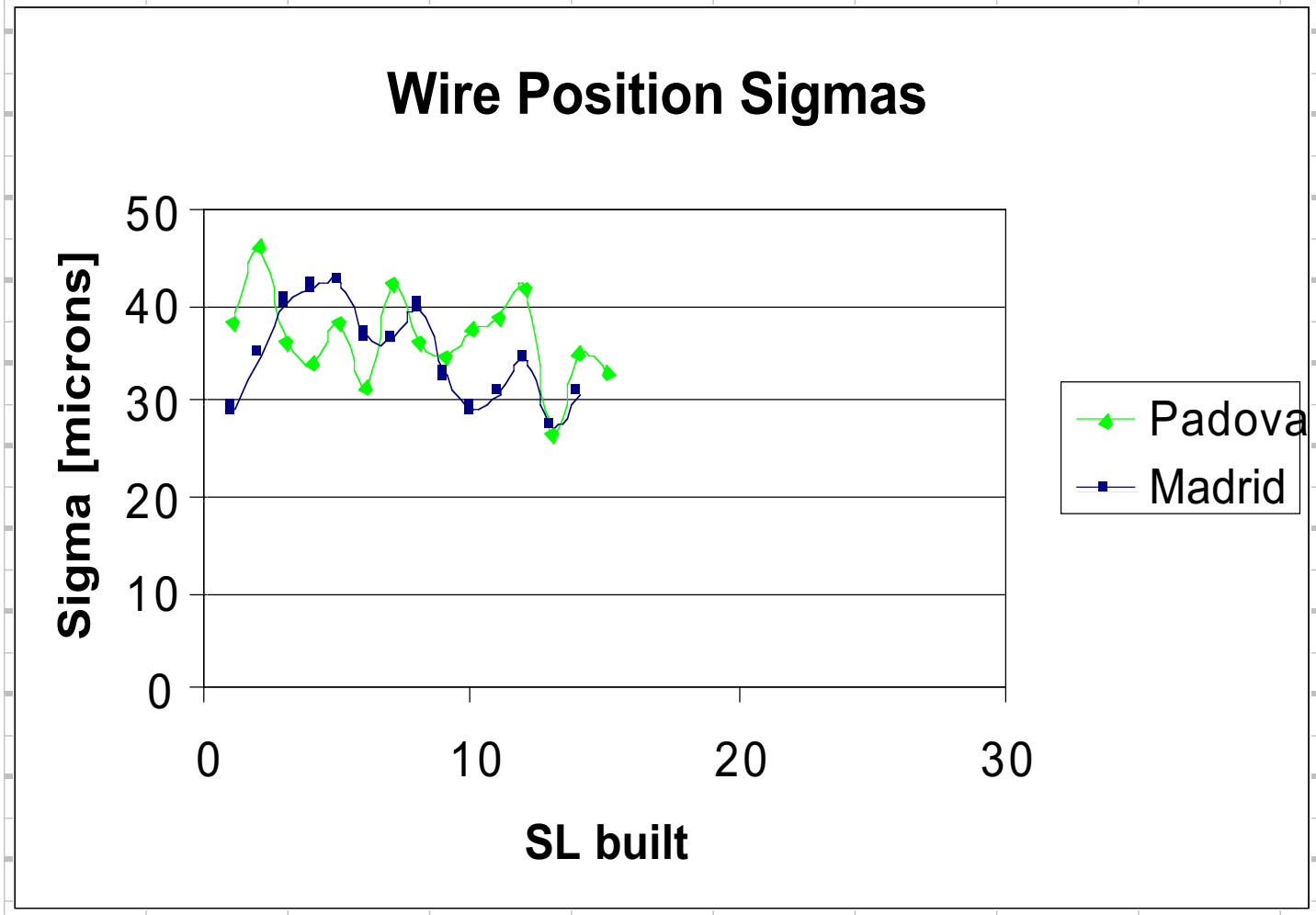

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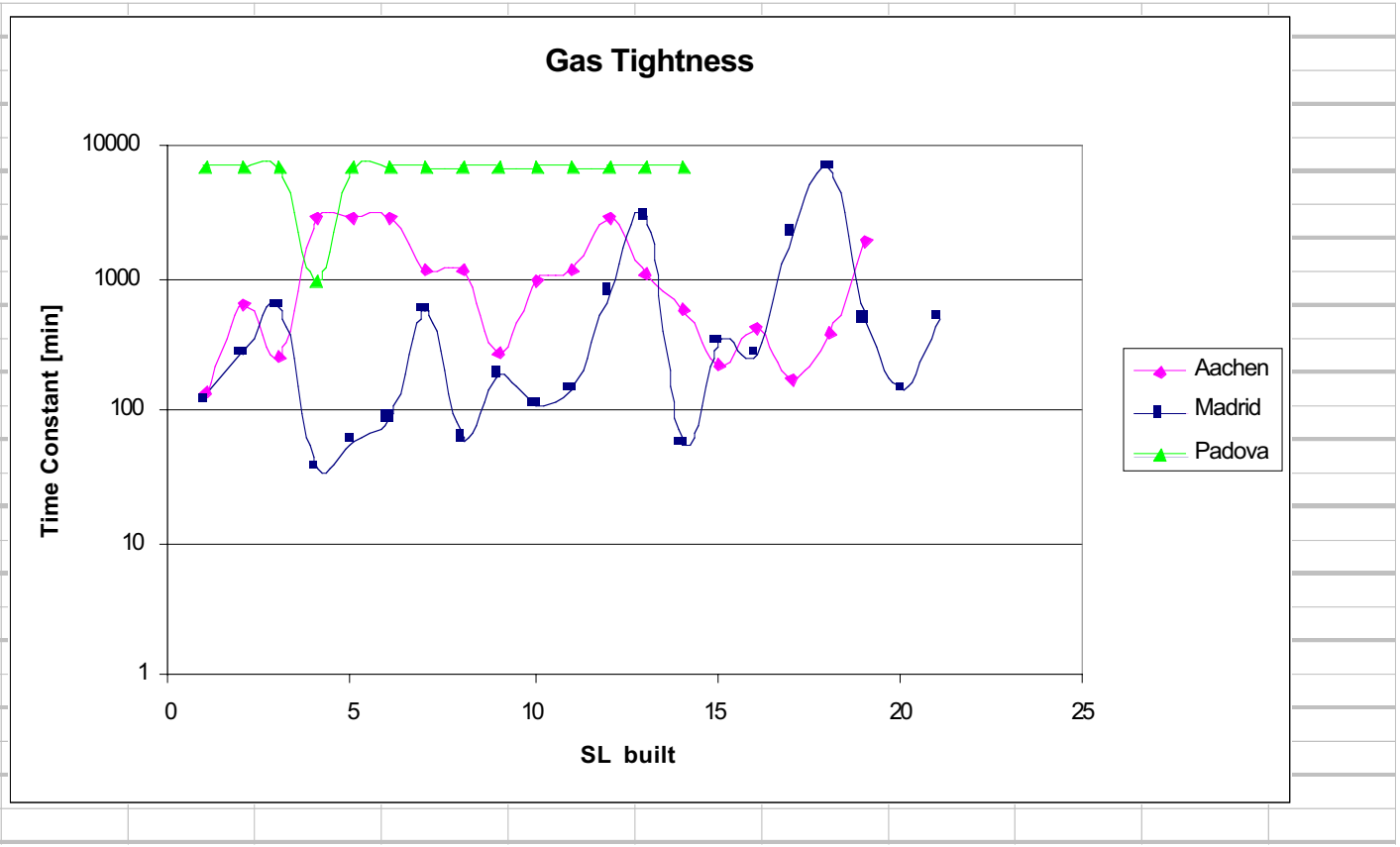

Noise Test

- **Test Condition:**
- **Connect or disconnect HV ?**
- **Connect channels to scalers**

- **Results should include:**
- **Peak value, dispersion and number of wires with noise larger than a defined value (tbd)**
- **Acceptable number of dead channels should be cross checked with the related trigger**
- **inefficiency,**
- **A similar study should be done to fix the number of channels with noise larger than a vaule tbd**
- **in function of the dead time introduced in the BTI.**

- **Acceptance Limits:**
- **3 limits 200 Hz, 500 Hz and 1 KHz (Padova)?**

- **Study of the rate of after pulses**
- (that generate the queue of the time distributions. It was reported ,as it obvious that the rate depends strongly on the gas gain,and Fabrizio pointed out that Q4 at CERN seems to reach the nominal performance of 250 micron and full efficiency at a Vamp of 1750 V ,instead of the 1800 assumed below as reference)
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Test with Cosmic rays at Production Site

Test Conditions:

HV: + 3600 V, + 1800 V, - 1200 V at typical CERN pressure of 970mbar,to be rescaled

Threshold: 15 mV = Vthr - Vref (where reference voltage V_ref = 1.5 V)

O2: < 500 pm

Rescaling factors:

1.03 [Padova=0m], 1.01 [Aachen=150m], 0.96[Madrid=600m]

Expected results:

> efficiency/cell

> mean time/column (mean and rms)

(Mean Time depends on several factors as T0/cut on angle of track /timing of scintillators)

> drift time distribution: "to be looked at"

> average plateau / layer: Padua suggested a HV-efficiency scan near the beginning of the plateau

From the DTIC minutes of 6th March 2002

Let me remind the recommendations from the last phone conference, data should be made available on:

0) gas tightness : currently the minimum acceptable deacy time was established to 140' when measured at 50mB local overpressure (see below for the definition of "local") .An overpressure test at 100 mB (CERN safety valve) shlu de done for few minutes (?).

1) noise figures of wires : peak value, dispersion and number of wires with noise larger than a defined value (tbd)
>Data were shown by Mary Cruz and Ezio in the general meeting that should allow to fix some reference figures.
2) F-End behavior from test pulse at various thresholds (indications expected from Matteo)
3) efficiency/cell
4) MT dx and sx ,MT1 and MT2
5) Time distributions (to be looked at)
6) Positioning of wires
7) dead channels and motivation

The acceptable number of dead channels should be cross checked with the related trigger inefficiency,a similar study should be done to fix the number of channels with noise larger than a vaule tbd in function of the dead time introduced in the BTI.

Also important should be a study of the rate of after pulses (that generate the queue of the time distributions. It was reported ,as it obvious that the rate depends strongly on the gas gain,and Fabrizio pointed out that Q4 at CERN seems to reach the nominal performance of 250 micron and full efficiency at a Vamp of 1750 V ,instead of the 1800 assumed below as reference.

For 1) 3) 4) and 5) reference voltages should be defined,different for different sites: it was assumed that the operating point of Q4 at CERN (970 mB) are –1200/1800/3600 and that these voltages shoud be scaled following a law dV ~ 2 dP. Howoever this law should be confirmed after a cross check of measurements on the gas gain (chambers should be tested at the same gain).

As for threshold we fixed 5 fC that are nominally obtained with Vt = 1500 +- 50 mV.

It was pointed out that MT depends on several factors as T0/cut on angle of track /timing of scintillators .(to be clarified ,if possible).

Also a precise rule for the computation of efficiency is needed (actually 3out of 4 ,but we should fix parameters of acceptance for the 3 and for the fourth track)

A Pool for all QC Test Results

Case 1

QC Tests Data are collected centrally into a General Pool and they are analyzed centrally.
Padova Local Pool is designed to be also a General Pool

Results are then naturally collected in the general pool

Standard Data Format is mandatory

Local procedures of testing/data analysis has to be circulated to understand data comparison

Case 2

does not exclude Case 1

- Padova and Madrid have
- organized a Local Pool of QC
- Test Results
- Locally QC people analyze and organize results on a Web page
- QC Test Results can be then merged the a general pool without reanalyzing them.
- Standard data format is mandatory
- Local procedures of testing/data analysis has to be circulated to understand data comparison

Detailed Procedures at Production Sites

What to test ---- QC book

How to test at Production Sites conditions

Tolerance and rejection limits ----- QC book

Written document/schema/table/….

QC Tests Data Format – Ascii Format

- **- wire position**
- **- First I-beam position**
- **- First strip position**
- **- Cathodes HV contacts**
- **- Strips HV contacts**
- **- wire tension**
- **- ref block position**
- **- gas tightness**
- **- gas purity**
- **- HV test**
- **- SL thickness**
- **- HoneyComb panel planarity**
- **- noise**
- **- SL alignment inside chamber**
- **- SL tilt inside chamber**
- **- Chamber thickness**
- **- Cosmics**