ATLAS Internal Note
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EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN/PPE/ATLAS/TILECAL
ATLAS experiment

REPORT on FABRICATING of ATLAS HADRON CALORIMETER PROTOTYPE #5 in DUBNA

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3. Billets preparation for contour machining

After cutting and grinding all billets had up to 5mm of nonplanarity. To obtain the satisfactory planarity all billets passed necessary corrections by rolling.

4. Billets final machining (on contour) and holes drilling.

4.1. Master plates production.

4.1.1. Preparatory works; rigging.

For master plate contour machining we prepared 2 auxilary elements (**rigging**): template and support plate with the base pins - so named **drill jig**. (See Fig.4) Machining was done on 2 shop-machines. On each one was put 4 plates stack. For machining was used end milling cutters.

To assemble billets in auxilary fixing element (rigging) each billet had 3 "basic holes" . They were done on high precision coordinate - boring shop machine.(See Fig.5).

4.1.2.

To drill holes we prepared high precision "conductor",i.e.**drill jig**, with 3 different renewable jig bushings:

- ⌀ 7.6mm for the drill
- ⌀ 7.85mm for the core drill
- ⌀ 8.0mm for the reamer

Drilling of holes was done through the drill jig using simultaneously 2-3 plates stack. Relative orientation plates/drill jig was done through the same 3 basic holes, which were also using when edge machining.

The holes diameters were controlled by 2 plugs (corks) - insertable and not insertable ones (first can move "in", last one - not).

Interaxis distances were controlled on high precision coordinate - boring machine (periodically during the whole production cycle).

4.2. Outside plate contour control

After master plates passed contour machining we took top and bottom plates from each stack for control measurements:(See Fig.6)

Anticorrosion cleaning and protection was reached by ortophosphorous acid (50% concentration in water).

5. Spacers fabrication

- base holes drilling $\varnothing\ 8^{+0.01}$ mm
- machining of A-surface
- machining of C-surface
- machining of D- and E-surfaces
- h_1 and h_2 dimensions control (See Fig.7)

6. Edge plates (S = 20mm) production

These plates surface machining was done on **jig boring mill** alternately from both sides in order to obtain satisfactory nonplanarity with consequent polishing.

All $\varnothing$ 6.5mm holes final mashining was done on coordinate - boring mill.

Anticorrosion protection: by ortophosphorous acid.

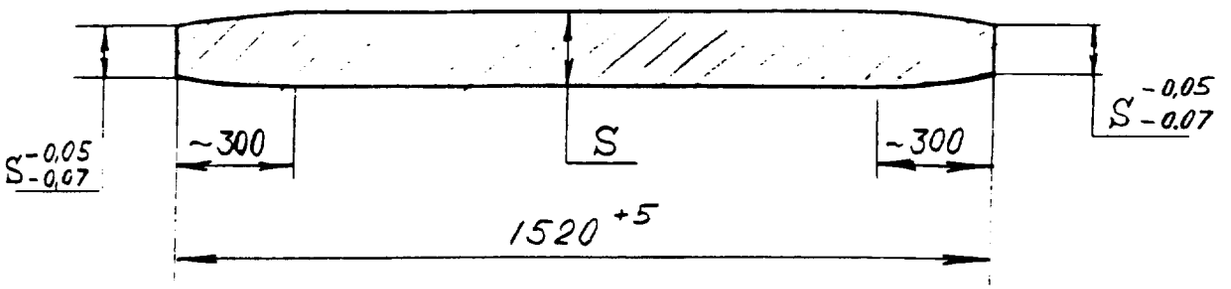


Fig. 1.

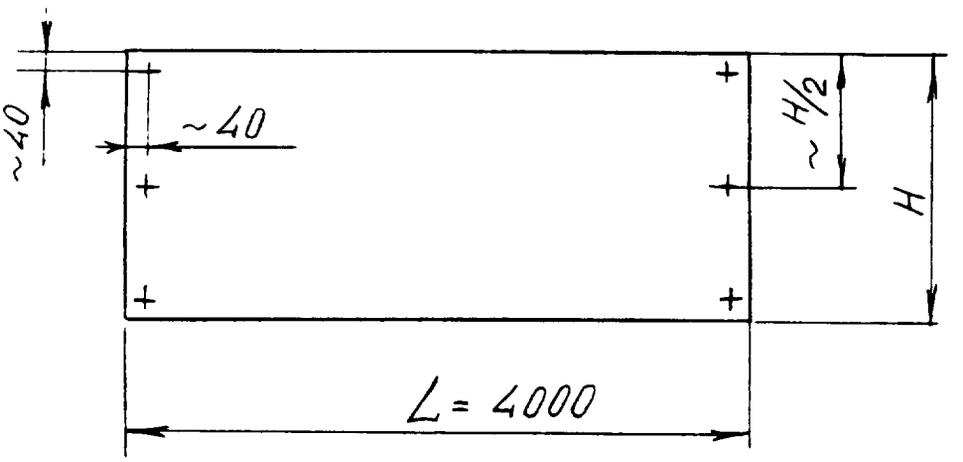


Fig. 2.

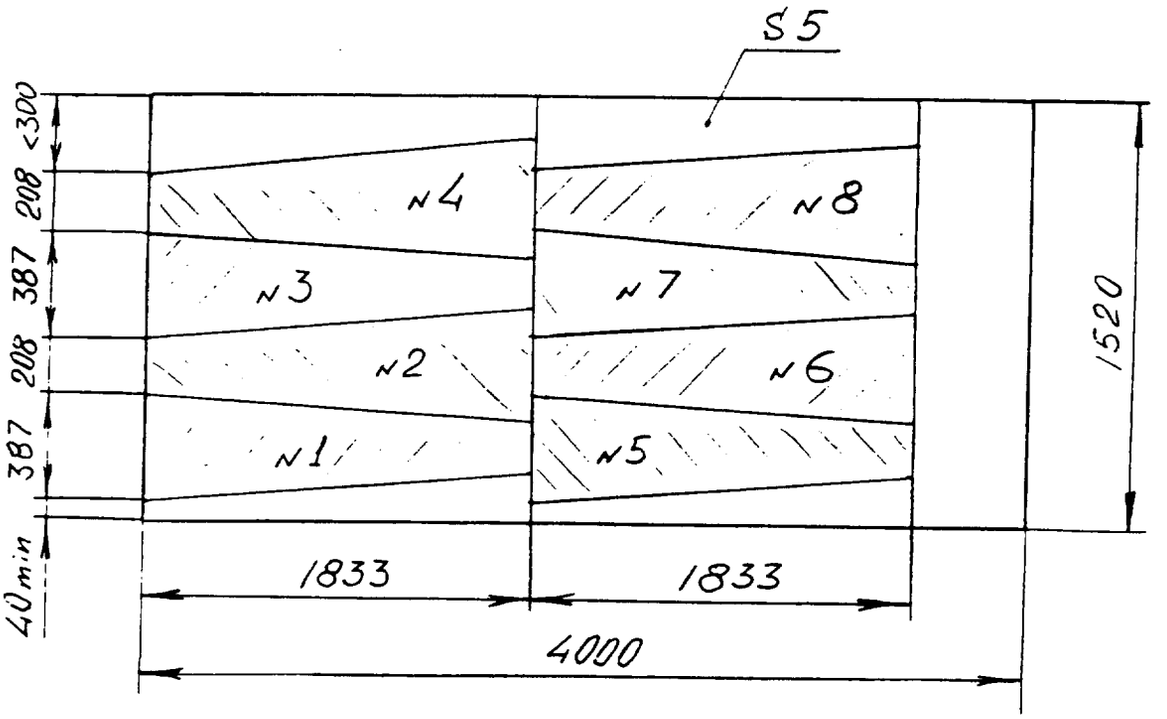

S5
<300
208
387
208
387
40 min
N4
N8
N3
N7
N2
N6
N1
N5
1520
1833
1833
4000

Fig. 3.

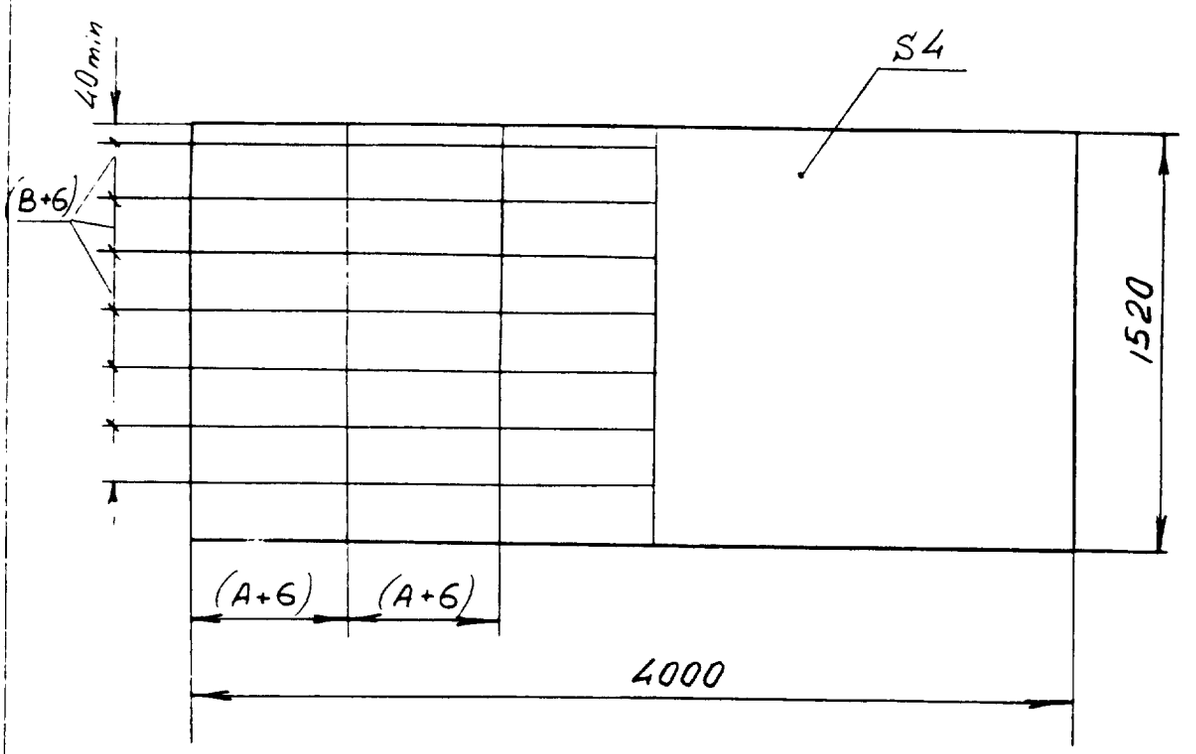

40 min
S4
(B+6)
1520
(A+6)
(A+6)
4000

Fig. 4.

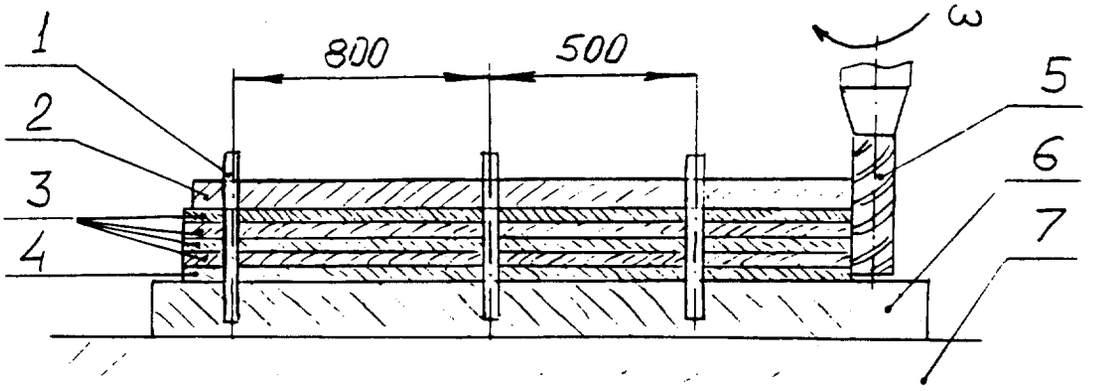


Fig. 5: 1 - pin
2 - template
3 - master-plate billets set
4 - bottom plate (no master-plate)
5 - milling cutter
6 - support plate
7 - shop-machine table

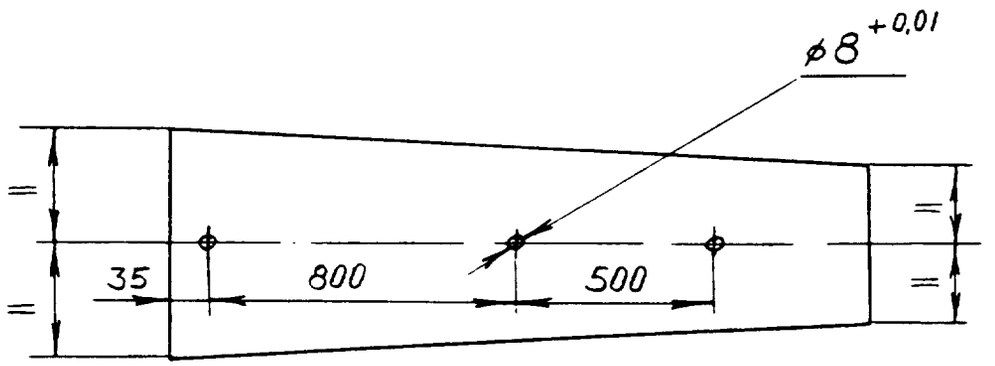


Fig. 6.

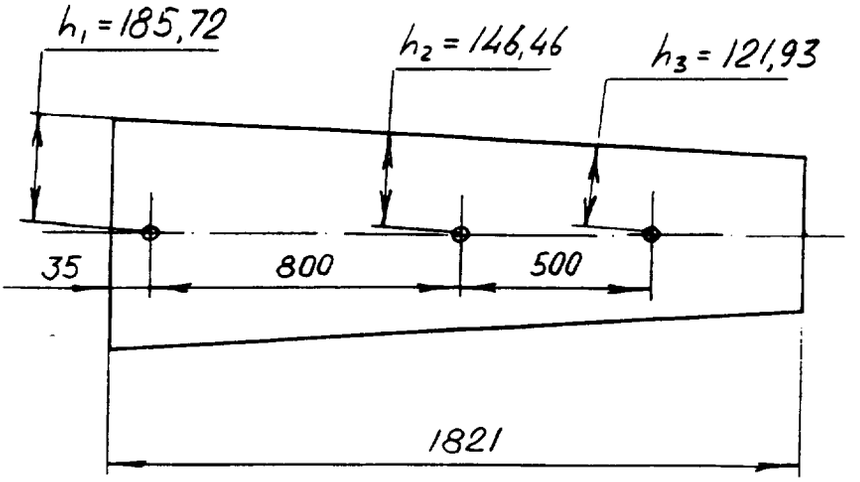


Fig. 7.

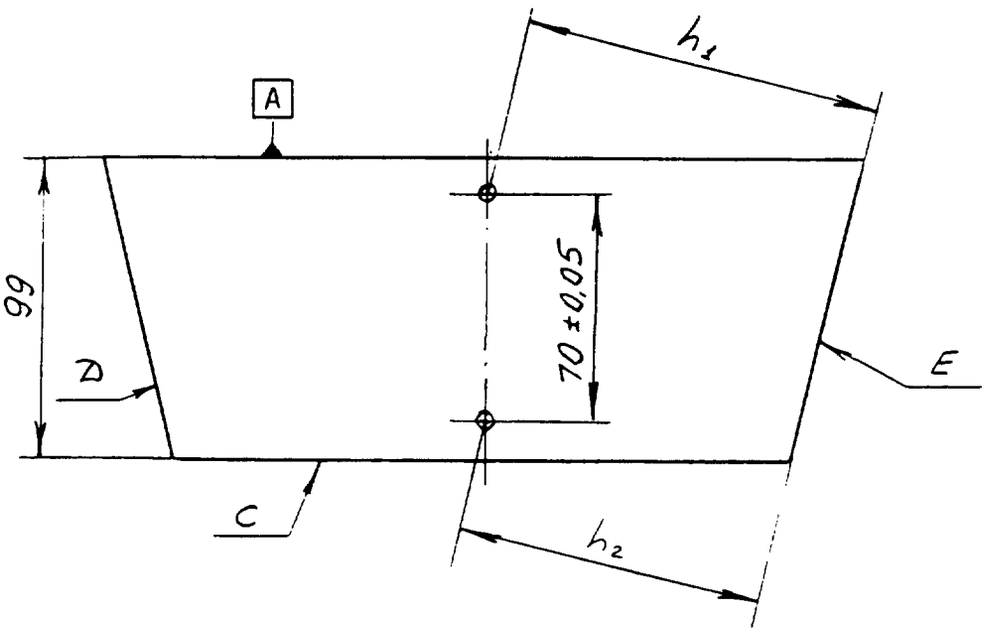
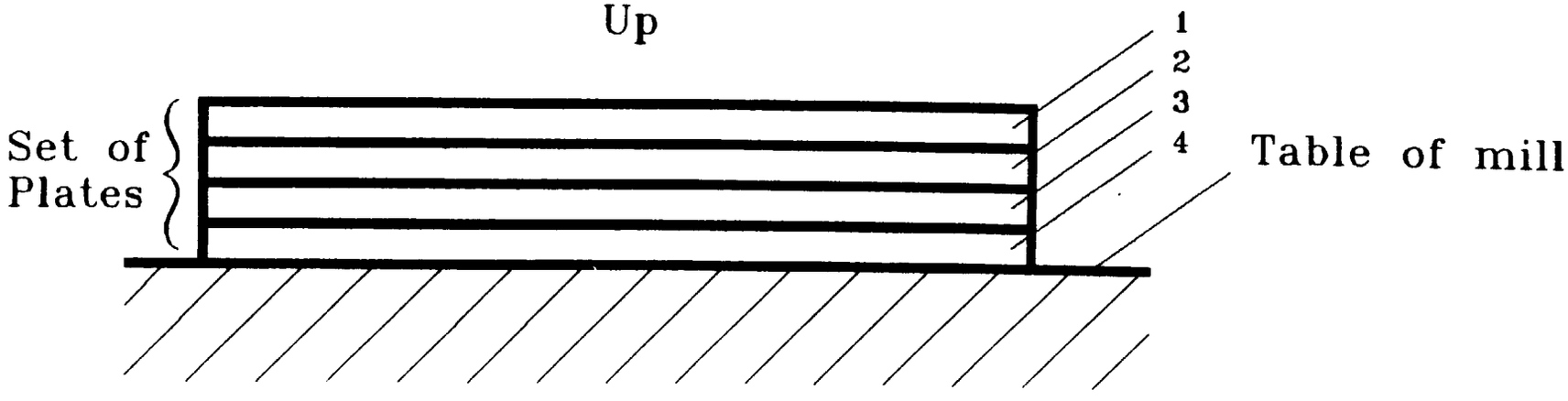
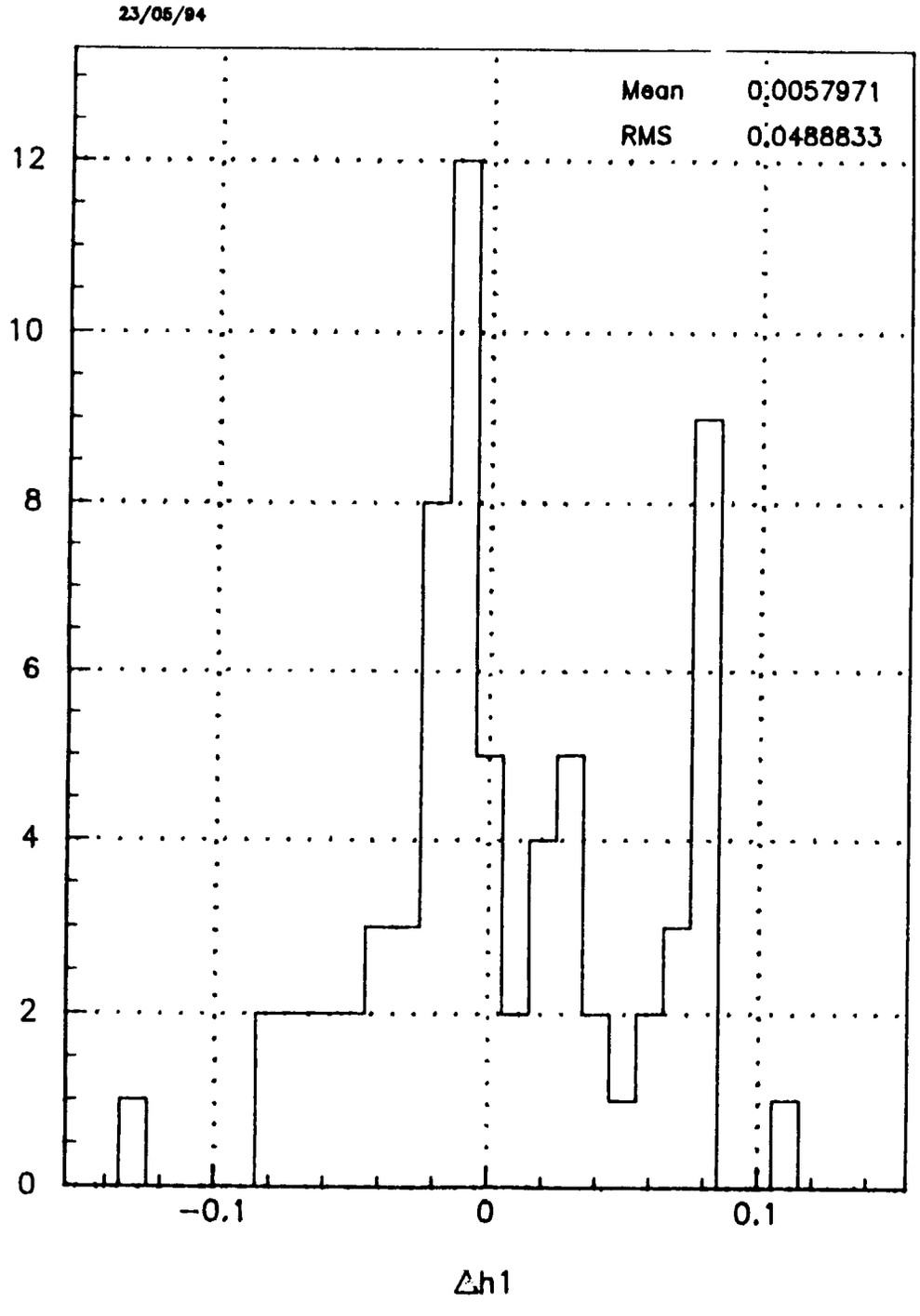


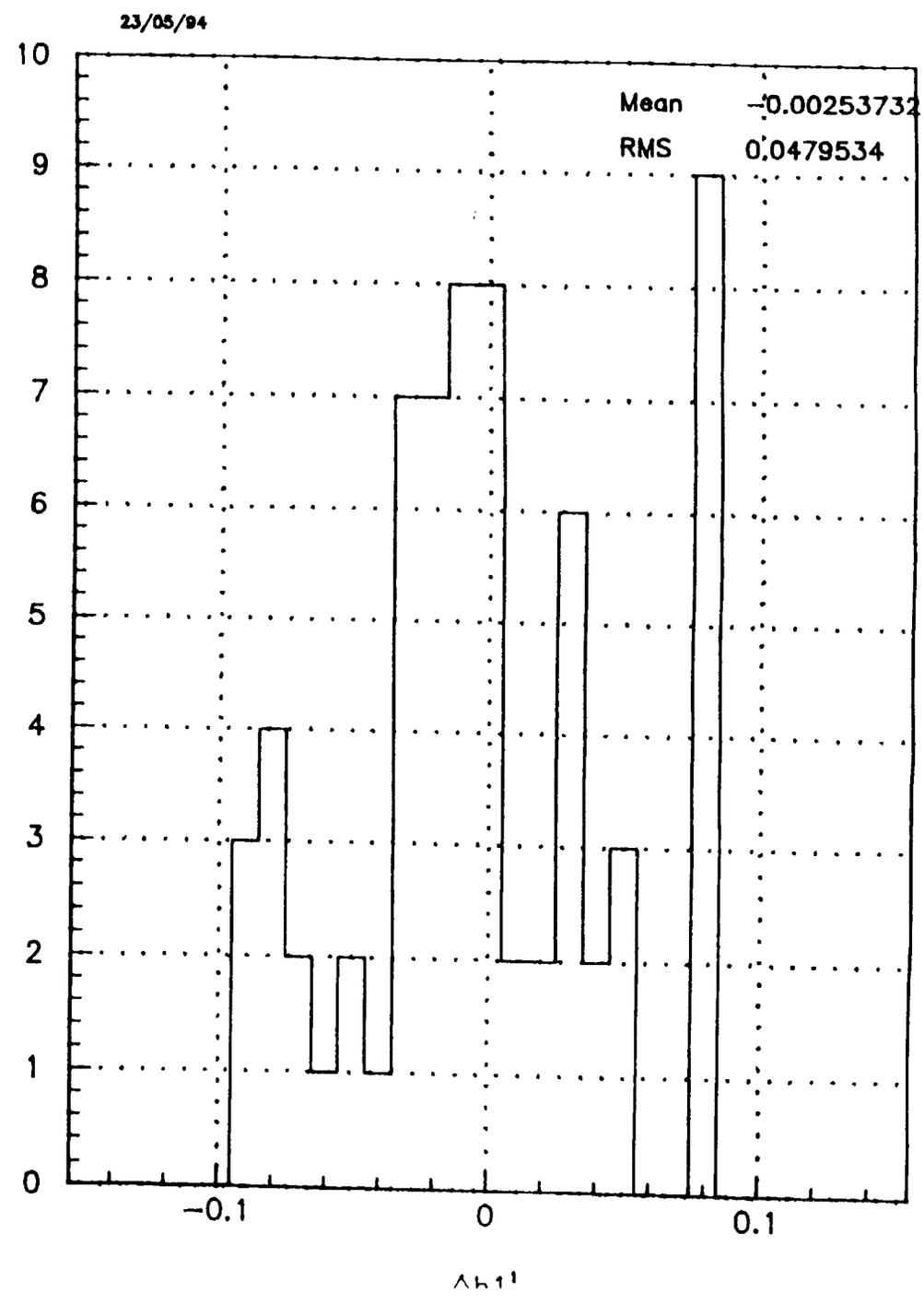
Fig. 8.

II. CONTROL of MASTER PLATES FABRICATION TOLERANCES

(5th sector of ATLAS hadron calorimeter prototype)


Up
1
2
3
4
Set of
Plates
Table of mill


23/05/94
Mean 0.0057971
RMS 0.0488833
12
10
8
6
4
2
0
−0.1
0
0.1
Δh1


23/05/94
Mean −0.00253732
RMS 0.0479534
10
9
8
7
6
5
4
3
2
1
0
−0.1
0
0.1

N of Sets	N of PLATE	Δh_1	$\Delta h_1'$	Δh_2	$\Delta h_2'$	Δh_3	$\Delta h_3'$	Δa	ΔA
1	1	0.00	0.00	0.00	0.00	0.01	0.02	0.005	0.00
2	1	0.02	0.03	-0.02	-0.02	0.03	0.03	0.005	0.05
3	1	0.00	0.00	0.01	0.03	0.03	-0.04	0.005	0.00
	4	-0.01	0.00	-0.03	0.00	0.01	-0.01	—	-0.01
4	1	-0.01	0.00	-0.04	0.00	-0.04	0.02	—	-0.01
	2	-0.01	-0.01	-0.01	0.00	-0.03	0.02	—	-0.02
	3	-0.02	0.00	-0.06	0.04	-0.01	0.09	—	-0.02
	4*	+0.11*	-0.02	0.09*	0.02	0.07*	-0.05	0.07	0.01
5	1	-0.01	0.00	0.00	-0.02	-0.01	0.03	—	-0.01
	2	-0.01	-0.02	-0.01	-0.02	0.00	0.01	—	-0.03
	4	-0.02	-0.01	-0.04	-0.02	-0.03	-0.03	—	-0.03
6	1	-0.04	-0.02	-0.04	-0.08	-0.10	-0.04	—	-0.06
	2	-0.08	-0.01	-0.07	-0.07	-0.03	-0.09	—	-0.09
	4	-0.04	-0.09	-0.06	-0.10	-0.05	-0.11	—	-0.13
7	1	-0.01	-0.03	-0.05	-0.06	0.00	-0.06	—	-0.04
	2	-0.01	-0.01	-0.04	-0.04	-0.02	-0.03	—	-0.02
	4	0.00	-0.01	-0.03	-0.06	-0.03	-0.06	—	-0.01
8	1	-0.03	0.00	-0.06	-0.06	-0.03	-0.07	—	-0.03
	3	-0.01	-0.03	-0.06	-0.05	-0.08	0.00	—	-0.04
	4	-0.01	-0.02	-0.04	-0.08	-0.01	-0.08	—	-0.03
9	1	-0.06	-0.07	-0.06	-0.07	-0.09	-0.06	—	-0.13
	3	-0.07	-0.07	-0.07	-0.10	-0.03	-0.11	—	-0.14
	4	-0.06	-0.03	-0.07	-0.08	-0.04	-0.14	—	-0.09
10	1	-0.02	-0.08	-0.10	-0.07	-0.11	-0.07	—	-0.10
	3	-0.02	-0.05	-0.04	-0.10	-0.07	-0.07	—	-0.07
	4	-0.07	-0.09	-0.08	-0.08	-0.15	-0.12	—	-0.16
11	1	0.01	-0.01	-0.01	-0.04	-0.03	-0.04	—	0.00
	4	0.00	-0.02	-0.02	-0.05			—	-0.02
12	1	-0.02	-0.02	-0.03	-0.02	-0.03	-0.03	-0.01	-0.04
	4	-0.03	-0.03	-0.04	-0.04	-0.07	-0.07	-0.03	-0.06
13	1	-0.02	-0.05	-0.06	-0.06	-0.05	-0.06	—	-0.07
	3	-0.05	-0.04	-0.09	-0.08	-0.06	-0.04	—	-0.09
	4	-0.13	-0.08	-0.15	-0.06	-0.05	-0.09	—	0.21
14	1	-0.03	-0.08	-0.10	-0.11	-0.11	-0.08	—	-0.11
	4	-0.02	-0.08	-0.09	-0.10	-0.11	-0.07	-0.03	-0.10
15	1	-0.01	-0.01	-0.09	-0.03	-0.09	0.02	—	-0.08
	4	0.03	0.03	-0.06	-0.05	-0.09	0.03	-0.03	-0.03
16	1	-0.02	-0.06	-0.06	-0.07	-0.09	-0.04	—	-0.08
	4	0.06	-0.09	-0.05	-0.08	-0.04	-0.04	—	-0.03
17	1	0.04	0.03	-0.05	0.09	-0.05	0.04	—	0.07
	4	0.03	0.08	-0.03	0.04	-0.04	0.03	—	0.11
18	1	-0.05	0.00	-0.06	-0.04	-0.05	-0.04	—	-0.05
	4	0.07	-0.18**	0.00	-0.13	-0.06	-0.03		-0.11
19	1	-0.01	0.03	0.00	0.08	-0.01	0.07	—	0.03
	4	0.06	-0.17	-0.01	-0.08	0.00	-0.03		-0.11
20	1	0.04	-0.01	0.02	0.04	0.03	0.04	—	0.03
	4	0.02	0.02	0.00	-0.06	0.06	-0.02		0.04

*the plate is machined one more

**the plate is bended

N of Sets	N of PLATE	Δh_1	$\Delta h_1'$	Δh_2	$\Delta h_2'$	Δh_3	$\Delta h_3'$	Δa	ΔA
21	1	0.01	0.04	-0.08	-0.03	-0.09	-0.01	—	0.05
	4	0.05	-0.02	-0.08	0.01	-0.04	0.00	-0.02	0.03
22	1	-0.04	0.05	-0.08	-0.03	-0.03	-0.03	—	0.01
	4	-0.08	0.01	-0.07	-0.06	-0.03	-0.03	—	-0.07
23	1	0.03	0.03	0.00	0.00	0.02	0.02	—	0.06
	4	0.08	0.08	0.03	0.03	0.07	-0.03	—	0.16
24	1	0.08	0.02	0.04	0.00	0.03	0.02	—	0.10
	4	0.08	-0.03	-0.01	0.02	-0.09	0.07	—	0.05
25	1	0.00	0.05	0.00	0.03	0.00	0.02	—	0.05
	4	0.03	0.04	0.02	-0.05	0.10	-0.04	—	0.07
26	1	0.08	0.08	-0.07	-0.03	-0.04	-0.06	—	0.16
	4	0.08	0.08	-0.06	-0.02	-0.04	0.02	—	0.16
27	1	0.08	0.08	0.01	0.04	-0.03	0.03	—	0.16
	4	0.08	0.08	-0.05	-0.06	0.03	-0.05	—	0.16
28	1	-0.01	0.03	0.01	0.01	0.04	0.06	—	0.02
	4	0.02	0.01	0.02	0.02	0.04	0.05	—	0.03
29	1	0.08	0.08	-0.03	-0.01	-0.03	0.01	—	0.16
	4	0.07	0.08	-0.05	-0.01	0.00	0.04	—	0.15
30	1	0.08	0.08	-0.03	0.04	-0.01	0.03	—	0.16
	4	0.03	-0.03	0.02	-0.07	0.03	-0.08	—	0.00
31	1	0.07	0.05	-0.03	0.00	0.01	0.01	—	0.12
	4	0.02	-0.03	0.00	-0.08	-0.01	-0.07	—	0.01

The results of measuring for two floonk plates.

	1	0.04	0.05	0.01	-0.00	-0.08	-0.08		0.09
	2	0.17*	+0.12	0.11*	0.00	0.29*	-0.08		0.29*

*After machining again

		0.02		-0.03		-0.13			0.014