ISR RUNNING-IN

Run 89. Pressure versus beam studies
15 GeV/c, 20 bunches, FS 15. Stacking at the bottom

Clearing electrodes (3.5 kV) never dropped out during this run.

All gauges set to 10^{-6} torr max. during run. Extensive print-outs made (with E. Fischer).

Stack 1

6.3 A reached in one go. Limited by saturation, stacking downwards, very fast decay, but no sudden loss.

All pressures > 10^{-8} torr printed out together with currents, every 20 s.

Table 1 shows the situation just before, and just after, maximum current

VG 349.1
435 (in a magnet!)
749.6 (reaching 10^{-6} torr)

were the highest.

Stacks 2 to 8

During the rest of the run VG 749.6 was displayed on the PIDC recorder (blue trace) and VG 349.1, 435 were displayed on 2 separate recorders. The two last ones were moving very much in parallel throughout the run, in spite of the different nature of their location. VG 749.6 shows a somewhat different pattern, perhaps only due to different recorder time-constants.

Almost always, when the stacks were dumped, the PIDC + VG 749 recorder was run at 250 mm/min, showing the rate of pressure decrease, (e.g., Fig. 1). This information may be used to repeat Hereward's calculation of outgassing rate versus ionisation rate.

Stack 2

As stack 1. Saturation and stacking downwards at 6.05 A, $\sim 2 \times 10^{-7}$ torr on VG 749.6. Table 2 shows the 2 print-outs around max. pressure.

Stack 3

Was made at ½ rep. rate. 5.6 ampere (again limited by saturation and stacking down) were reached, again at $\sim 2 \times 10^{-7}$ torr at VG 749.6. Table 3 shows the print-outs.

Stack 4 (Fig. 1)

Normal rep. rate but with plateau of about 9 min. at 3.5 A.

6.0 A reached, again limited by saturation and stacking down, again at $\sim 2 \times 10^{-7}$ torr on VG 749.6. Pressure print-outs with K. Hübner.

Two short interruptions due to missing PS pulses produced the increased rate-of-increase followed by decrease of pressure effects described below.

The dumping of a 4.8 A stack + pressure decay at 250 mm/min. is also recorded on Fig. 1.

Stack 5 an unsuccessful attempt to make a twin stack.

Stacks 6, 7, 9

Stacking (partly in small steps) to maxima of 5.2, 5.5, 5.5 A respectively, scraped down in little steps from the inside, outside, above, respectively.

These stacks give detailed information on equilibrium pressure versus current, (cf. original paper roll).

Stack 8

as above, to 5.5 A, not scraped. Figs. 2 and 3 show how, by adding a few pulses from time to time, one can balance the beam current between 5.2 A and 5.5 A and the pressure (at VG 749.6) around 5×10^{-8} torr.

Table 4 is the print-out somewhere during the end of the >5 A period of Stack 6. Now VG 333.1 is the highest, not 749.6.

Table 5 refers to Stack 7 at 5.42 A. VG 333.1 is the only one reaching 10^{-7}. Table 6 is for Stack 8 under very similar conditions as Stack 7. VG 333.1 is again the highest.

Figs. 2, 3 and 4 show a new effect : stopping the stacking leads to a strong increase of rate of increase of pressure (apparently at 4.2 s after the last injection). Resuming the stacking leads to an immediate decrease of pressure. On the recordings of VG 349.1 and 435 this is not clearly visible, (but not fully exluded either).

Conclusions (in addition to the observation above about stacking and pressure)

Stacking at different rep. rates with or without plateau at 3.5 A, always seems to lead to a current limit at about the same pressure ($\sim 2 \times 10^{-7}$ torr at VG 749.6).

When the clearing voltages stay on, the limit takes the form of saturation, stacking downwards and fast decay (roughly 1.5 min^{-1}), but not sudden loss.

The general run to run improvement continues, 6.3 A in a single stack has been reached and equilibrium pressures $<10^{-7}$ torr are found for 5.2 to 5.5 A continuous beams.

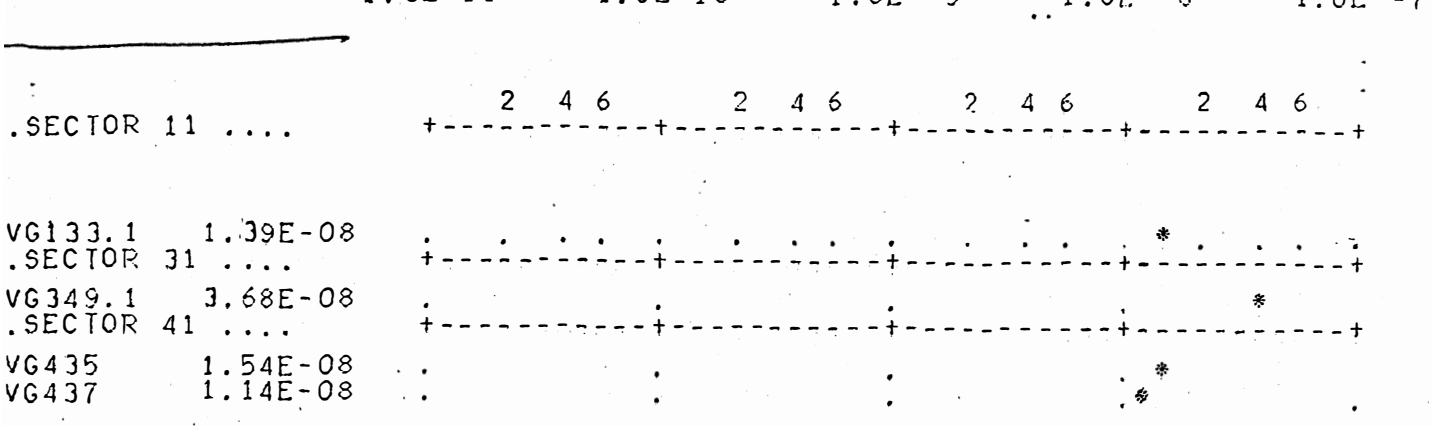
At first sight, the pressure for given current is roughly the same for scraped beams, wherever the scraping is done. I have not done a detailed analysis.

W. Schnell

Distribution

ISR Group Leaders
Running In Committee
Engineers in Charge
RF Group
E. Brouzet MPS
M. Höfert HP

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --



--- BEAM CURRENT: I = 6.165 A ---

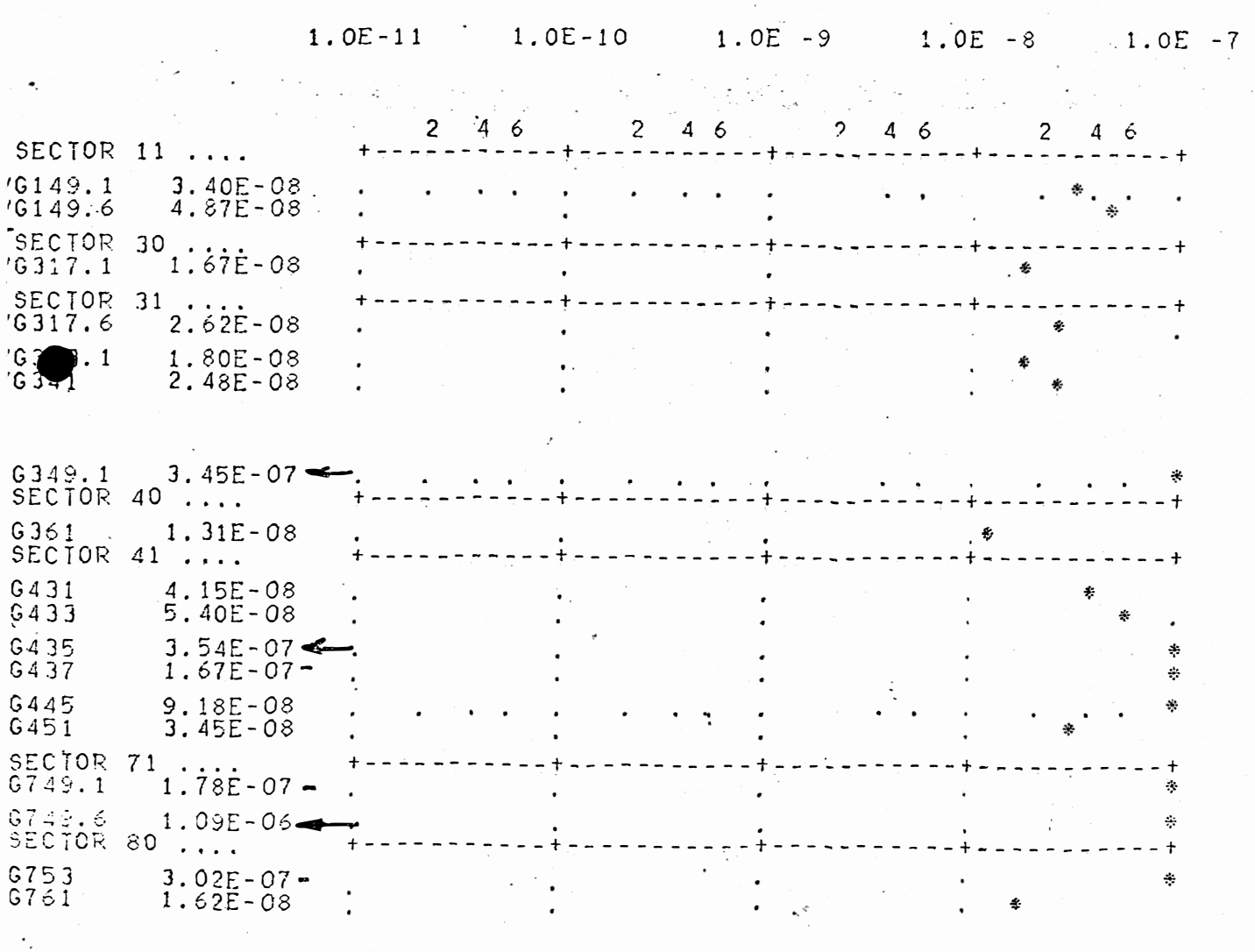
IME: 13H 32M 34S DATE: 1971-07-21

still sticking

>L (R1,1.0E+4)

Stack 1 to 6.3 A
then sticking downwards

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --



--- BEAM CURRENT: I = 5.490 A --- after maximum current.

```
--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES
 -- IN  TORR --
```

Tabelle 2

```
                      1.0E-11     1.0E-10     1.0E -9     1.0E -8     1.0E -7

                        2  4 6       2  4 6      2  4 6      2  4 6
..SECTOR 31 ....      +-----------+-----------+-----------+-----------+
 VG349.1    3.02E-08  .  .  . .   .   .  . .  .   .  . .  .     *.  . .
..SECTOR 41 ....      +-----------+-----------+-----------+-----------+
 VG435      2.68E-08  .           .           .           .     *
 VG437      1.67E-08  .           .           .           .  *

..SECTOR 71 ....      +-----------+-----------+-----------+-----------+
 VG749.6    3.19E-08  .           .           .           .      *    .

   --- BEAM CURRENT: I =  5.870 A ---

TIME: 14H 18M 28S     DATE: 1971-07-21
```

Stack 2
still stacking

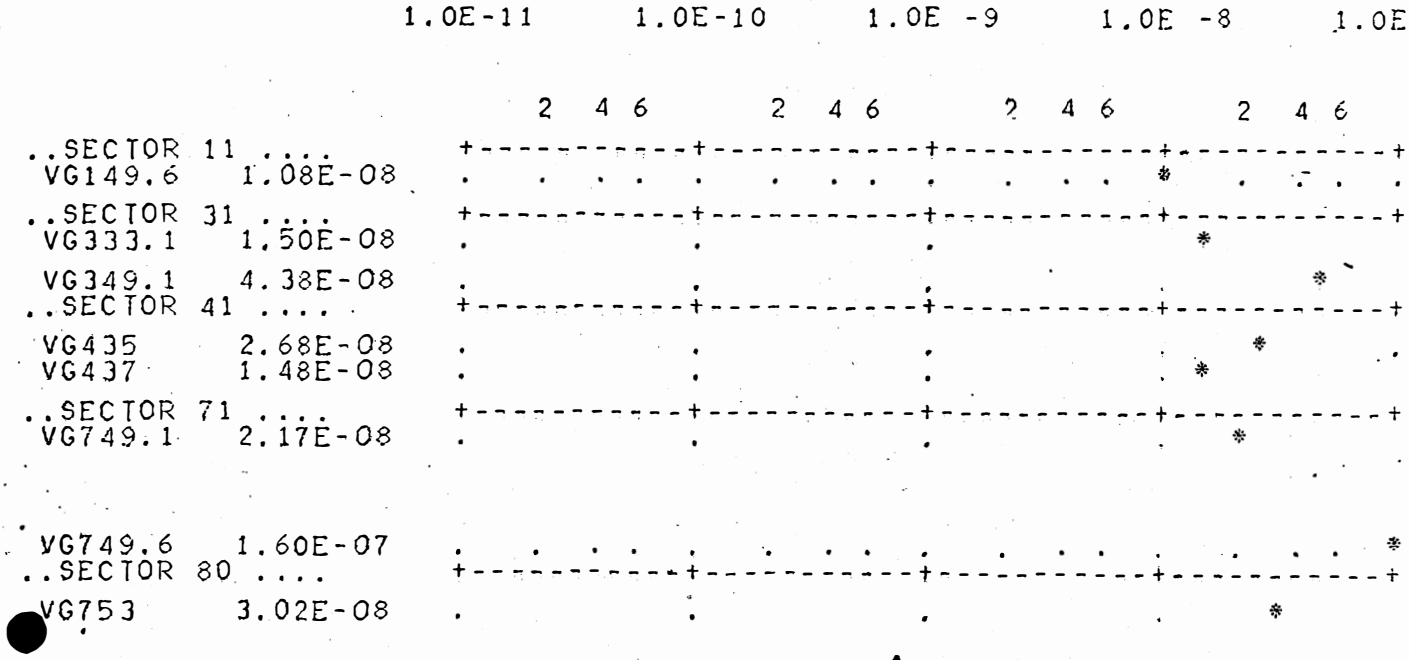
```
PLVG(R1,1.0E+4)

 --- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
  -- IN  TORR --

                      1.0E-11     1.0E-10     1.0E -9     1.0F -8     1.0E -7

                        2  4 6       2  4 6      ?  4 6      2  4 6
..SECTOR 11 ....      +-----------+-----------+-----------+-----------+
 VG149.1    1.83E-08  .  .  . .   .   .  . .  .   .  . .  .   *.  . . .
 VG149.6    2.62E-08  .           .           .           .     *
..SECTOR 31 ....      +-----------+-----------+-----------+-----------+
 VG317.6    1.28E-08  .           .           .           .*
 VG333.1    1.83E-08  .           .           .           .   *       .
 VG341      1.10E-08  .           .           .           .*
 VG349.1    1.12E-07  .           .           .           .           *
..SECTOR 41 ....      +-----------+-----------+-----------+-----------+
 VG431      1.73E-08  .  .  . .   .   .  . .  .   .  . .  .   *.  . . .
 VG433      1.88E-08  .           .           .           .   *
 VG435      1.12E-07  .           .           .           .           *
 VG437      6.42E-08  .           .           .           .         * .
 VG445      2.90E-08  .           .           .           .     *

 VG451      1.50E-08  .           .           .           . *
..SECTOR 71 ....      +-----------+-----------+-----------+-----------+
 VG749.1    1.38E-07  .  .  . .   .   .  . .  .   .  . .  .   .  . .  *
 VG749.6    8.48E-07  .           .           .           .           *
..SECTOR 80 ....      +-----------+-----------+-----------+-----------+
 VG753      2.23E-07  .           .           .           .           *
 VG761      1.33E-08  .           .           .           .*          .

   --- BEAM CURRENT: I =  5.490 A ---

TIME: 14H 18M 48S     DATE: 1971-07-21
```

Stack 2 stopped

```
PLVG(R1,1.0E+4)
```

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES --- before 5

-- IN TORR --



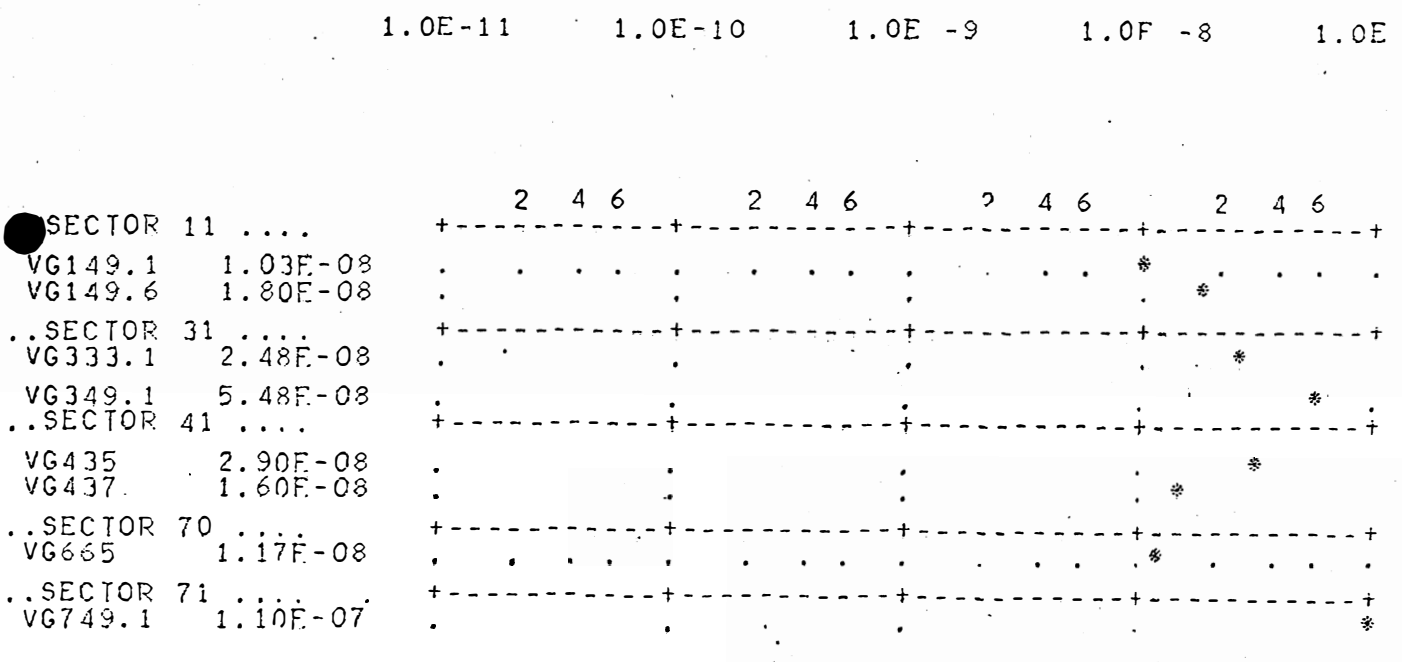
--- BEAM CURRENT: I = 5.550 A --- close to max

TIME: 14H 36M 27S DATE: 1971-07-21

Stack 3 ½ rep rate

PLVG(R1,1.0E+4)

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --



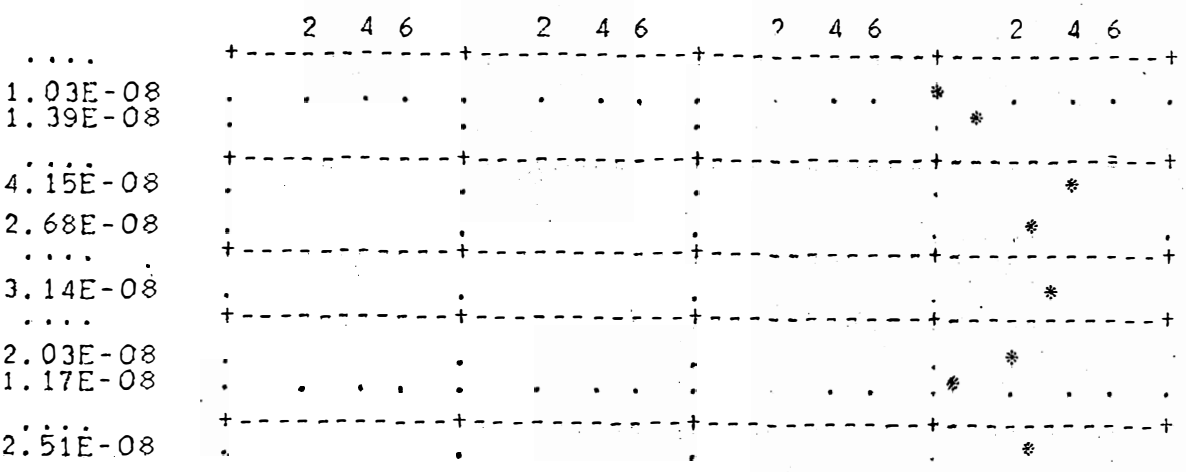
--- BEAM CURRENT: I = 5.290 A --- after stack steps

TIME: 14H 36M 47S DATE: 1971-07-21

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --

Table 4

1.0E-11 1.0E-10 1.0E -9 1.0F -8 1.0E -7



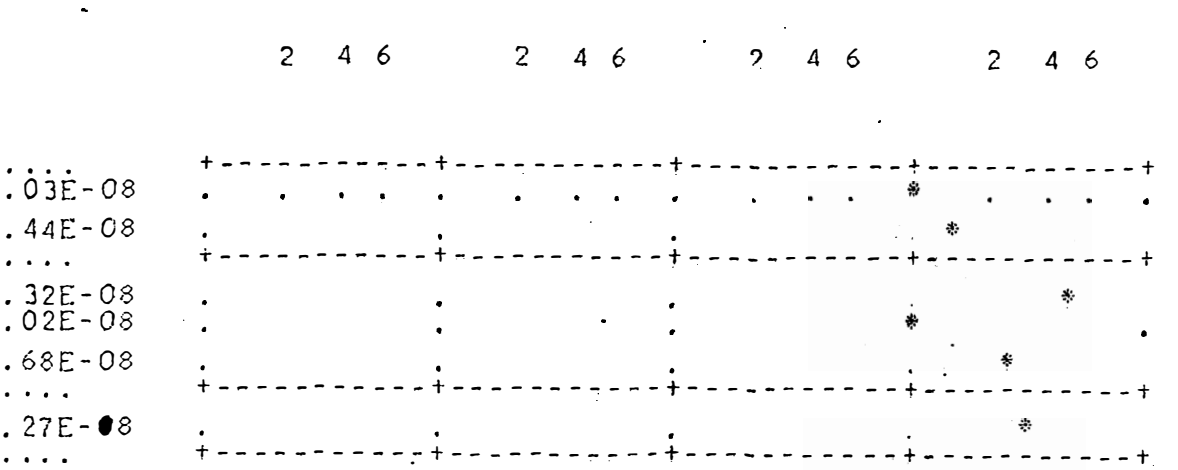
--- BEAM CURRENT: I = 5.210 A ---

TIME: 16H 18M 33S DATE: 1971-07-21

PLVG(R1,1.0E+4)

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --

1.0E-11 1.0E-10 1.0E -9 1.0F -8 1.0E -7



--- BEAM CURRENT: I = 5.200 A ---

TIME: 16H 18M 53S DATE: 1971-07-21

Stack 6
current dept > 5 A
for several minutes

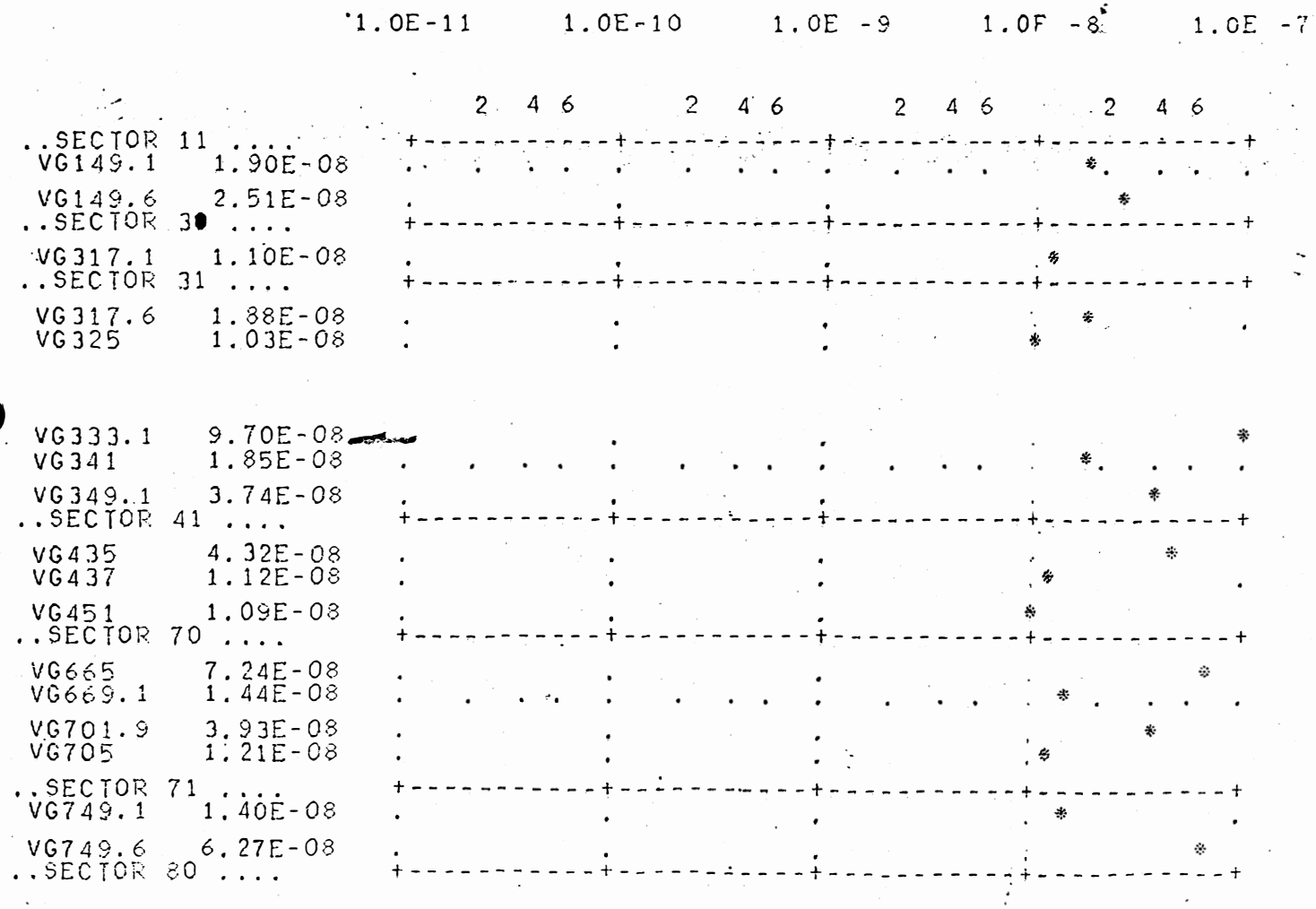
PLVG(R1,1.0E+4)

--- PLOT OF ULTRA-HIGH VACUUM GAUGES ---

Tafel 5

PLVG(R1,1.0E+4)

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --



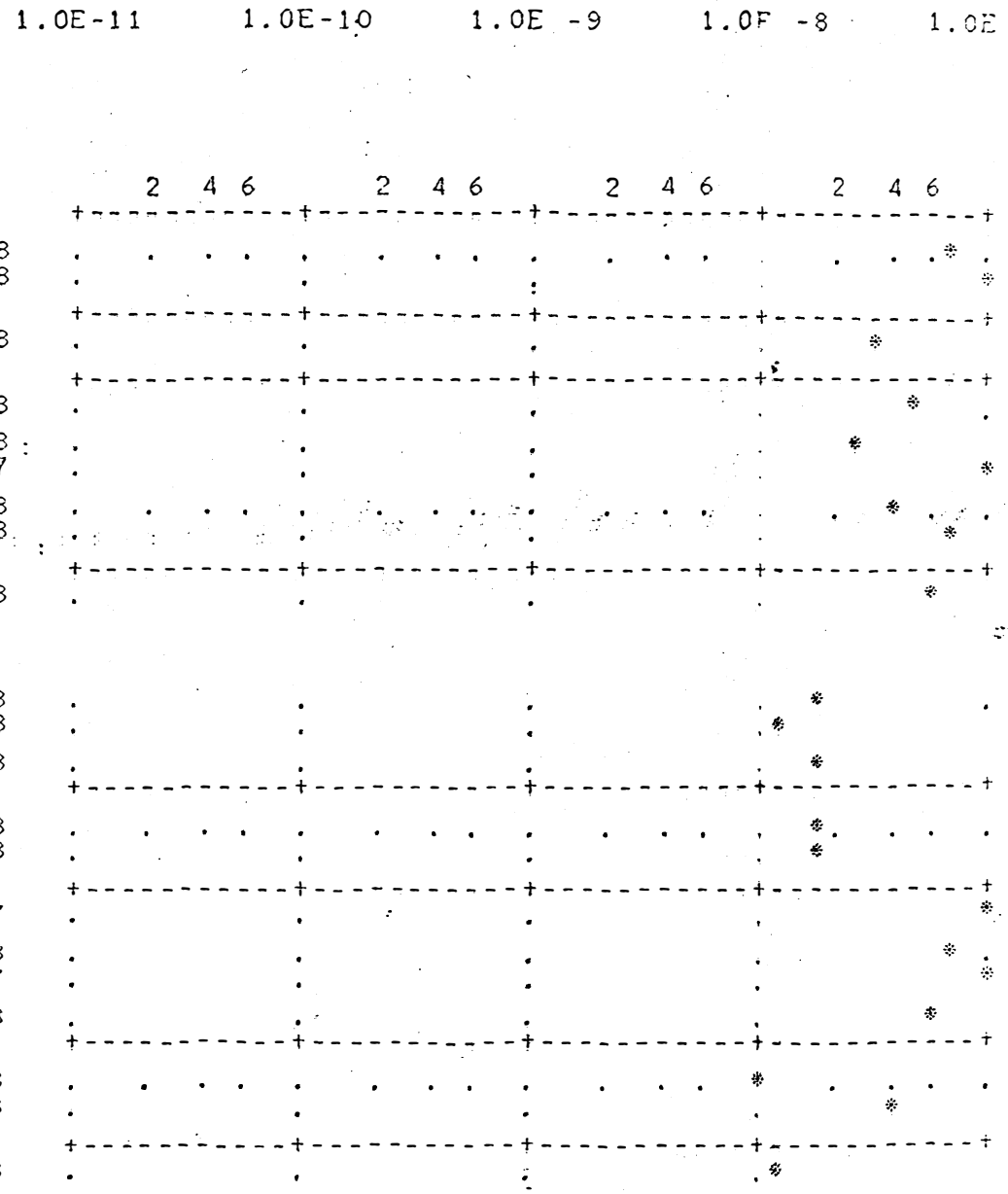
--- BEAM CURRENT: I = 5.415 A ---

TIME: 16H 50M 27S DATE: 1971-07-21

Stack 7
(ähnlich to 6)

Table 6

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --



--- BEAM CURRENT: I = 5.315 A ---

TIME: 17H 16M 20S DATE: 1971-07-21

Stack 8
(suite to 7)

PLVG(R1,1.0E+4)

--- PRESSURE PLOT OF ULTRA-HIGH VACUUM GAUGES ---
-- IN TORR --

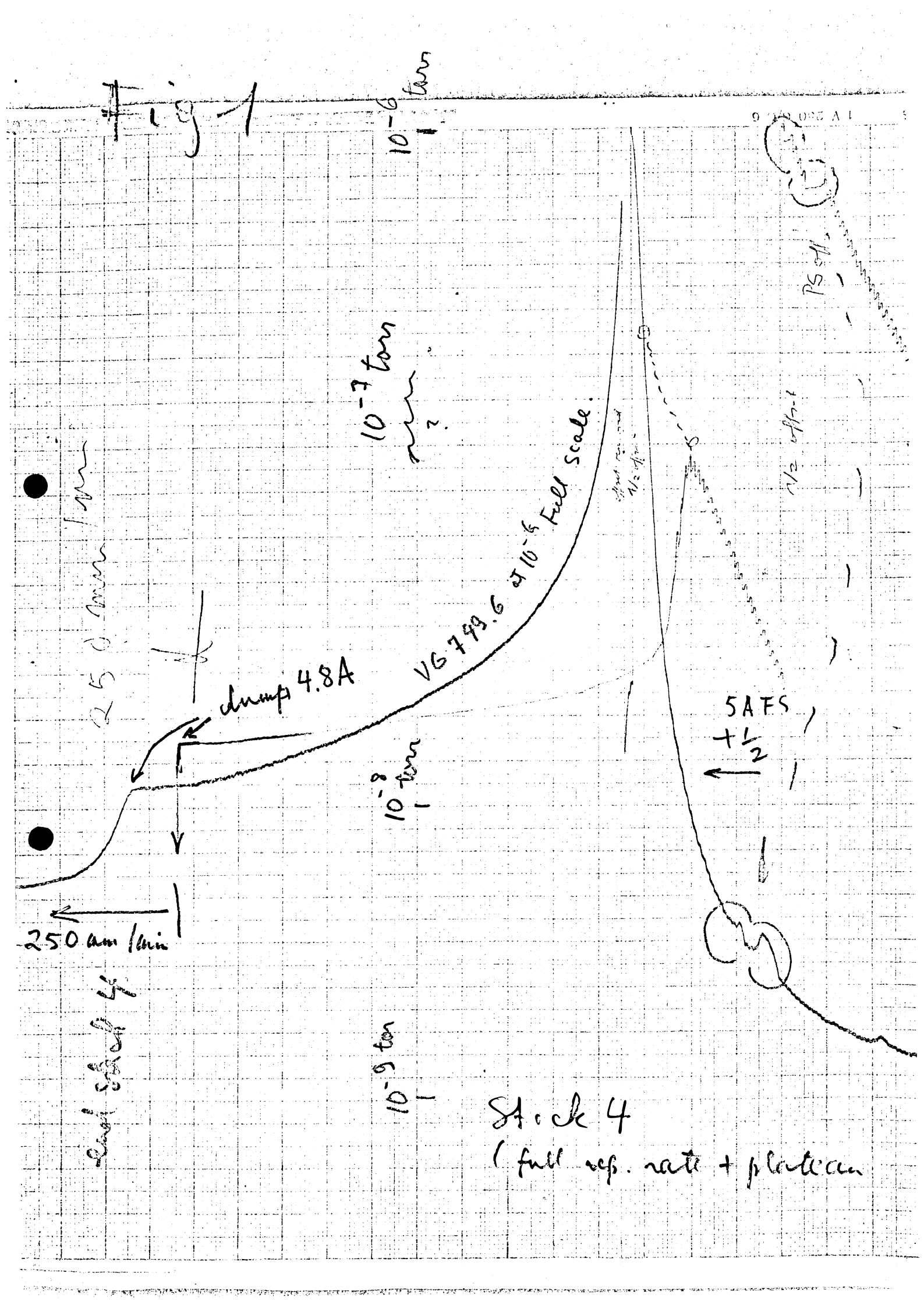


Fig 1
10^{-6} torr
10^{-7} torr
10^{-8} torr
10^{-9} torr
VG 749.6 at 10^{-6} Full Scale.
dump 4.8A
250 am/min
5 AFS
+½
Stick 4
(full resp. rate + plateau

Fig 2

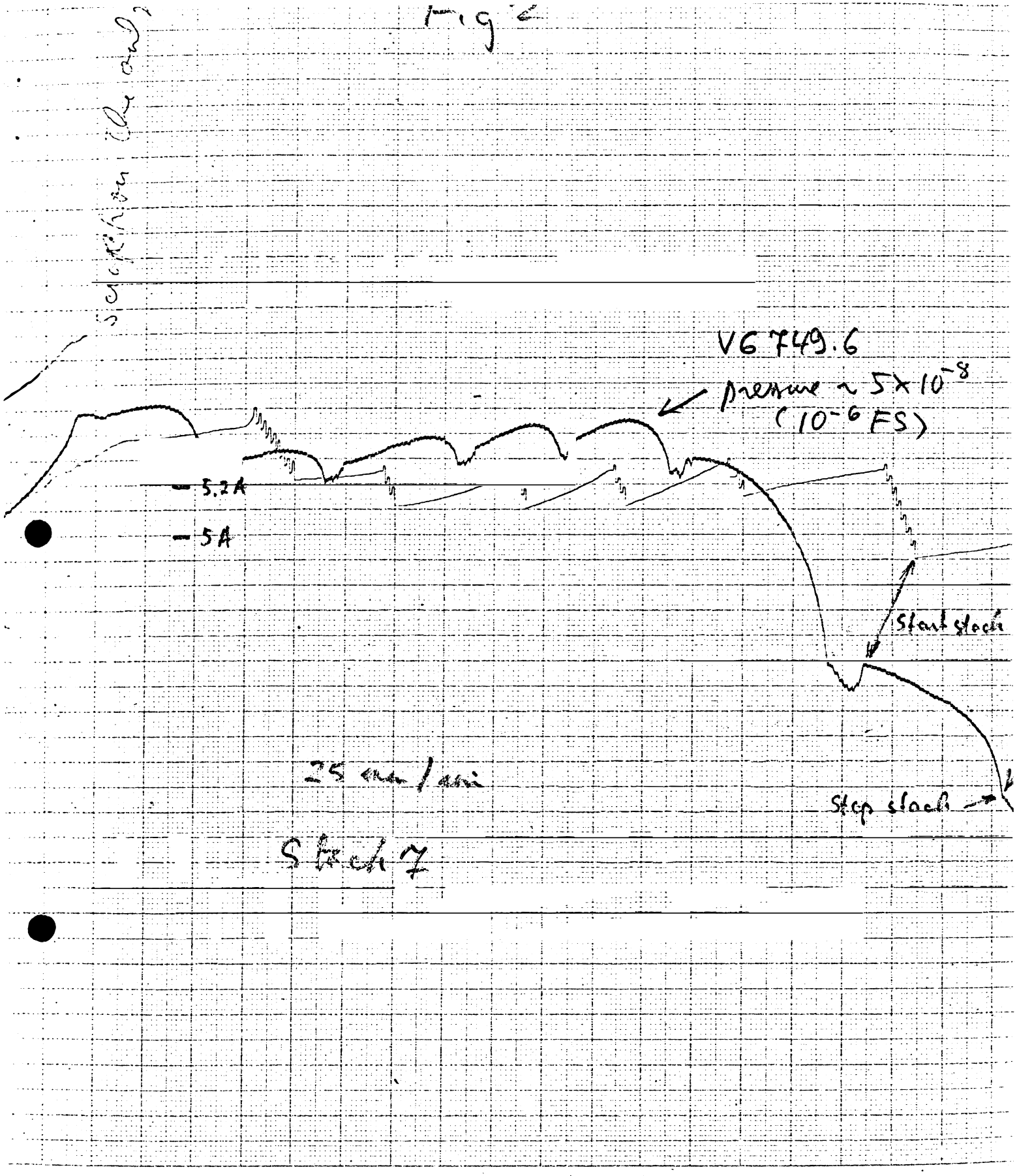
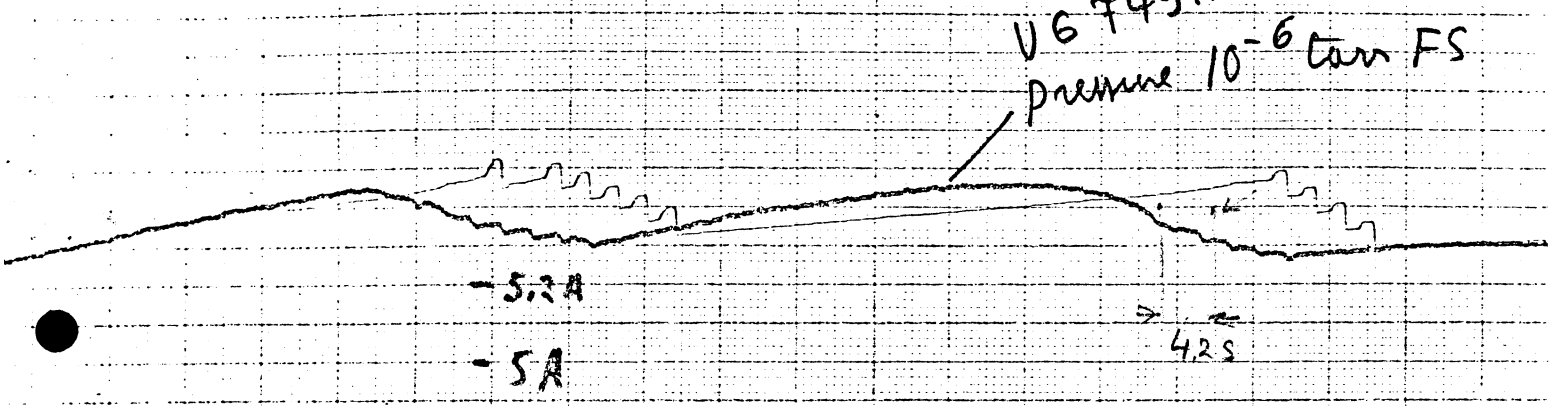

VG 749.6
Pressure ~ 5×10⁻⁸
(10⁻⁶ FS)
−5.2A
−5A
Start stack
Stop stack
25 mA/min
Stack 7

Fig 3



100 mm / min

Stack 8

Fig 4

Fig 4