UPDATED PARAMETERS FOR THE

AC MAGNET DESIGN

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Preliminary remark :

The following parameters are based on the lattice 83.04.
It is updating of those mentionned in note AC-12.

INTRODUCTION

The lattice design for the anti-proton collector, to be sited in the AA Hall, includes 24 dipoles and 56 quadrupoles*. Although these magnets are somewhat smaller than those in the AA ring, the design and construction philosophy is very similar to that employed on the larger magnets. The cores will consist of low carbon laminated steel, stacked and compressed between thick end plates. Energising coils are water cooled copper, insulated with glass or glass-mica tape and vacuum impregnated with epoxy resin.

DIPOLES

The effective length of the dipoles is 1.9513 m and the required field is 1.6T. Since the sagitta is only ± 32 mm, it was considered worthwhile to widen the pole by this amount and thus avoid the expense and complication of having a curved magnet and coils. In order to maximise straight-section space the coils will have bent-up ends. The extra cost of this is compensated by the fact that the coils can now be placed on the magnets' median plane, with a consequent saving in magnet steel.

Non-linear two-dimensional calculations, using the code PE2D, were used to determine the pole profile and to optimise the lamination size. Three-dimensional analysis of the end field will be done later, as an aid to the fitting of shims which will produce the required sextupole component.

QUADRUPOLES

Of the 56 quadrupoles, 12 are of one type (QW) and 44 are of another (QN). The QW's are required in those positions in the lattice where dispersion causes the beam to be particularly wide in the horizontal plane. The QN's have been made as narrow as possible in order to ease the problems of injection and extraction.

Since the two quadrupole types have different internal bore diameters, and each type has to act both as a focussing and a de-focussing lens, the diameters and turns/pole have been adjusted so that a given current will produce the same gradient in both the QW and the QN. Any small difference between the gradient-length integrals of the two types can be accommodated either by the use of end

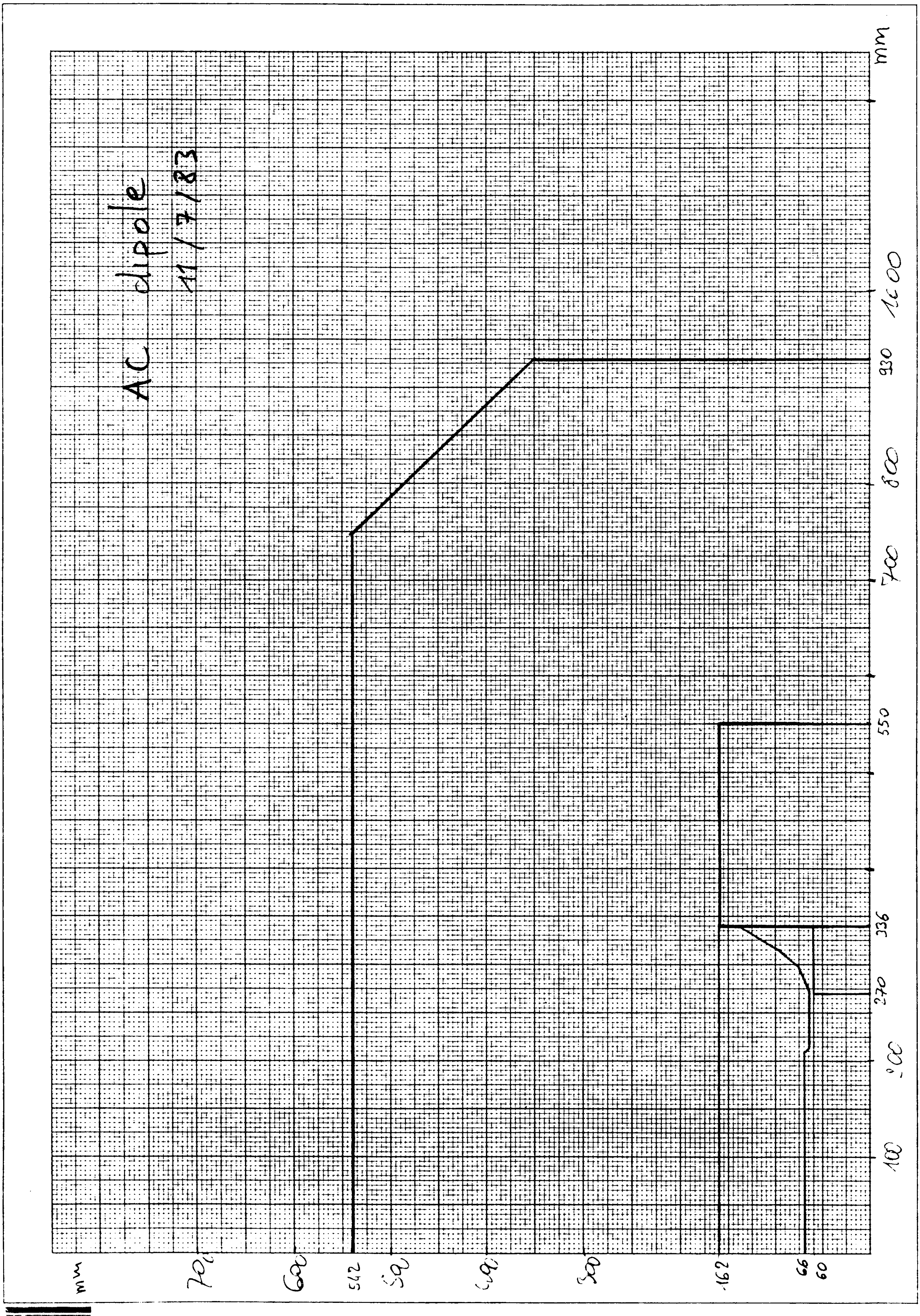
*One dipole and two quadrupoles will be modified due to injection constraints shims or by current shunting.

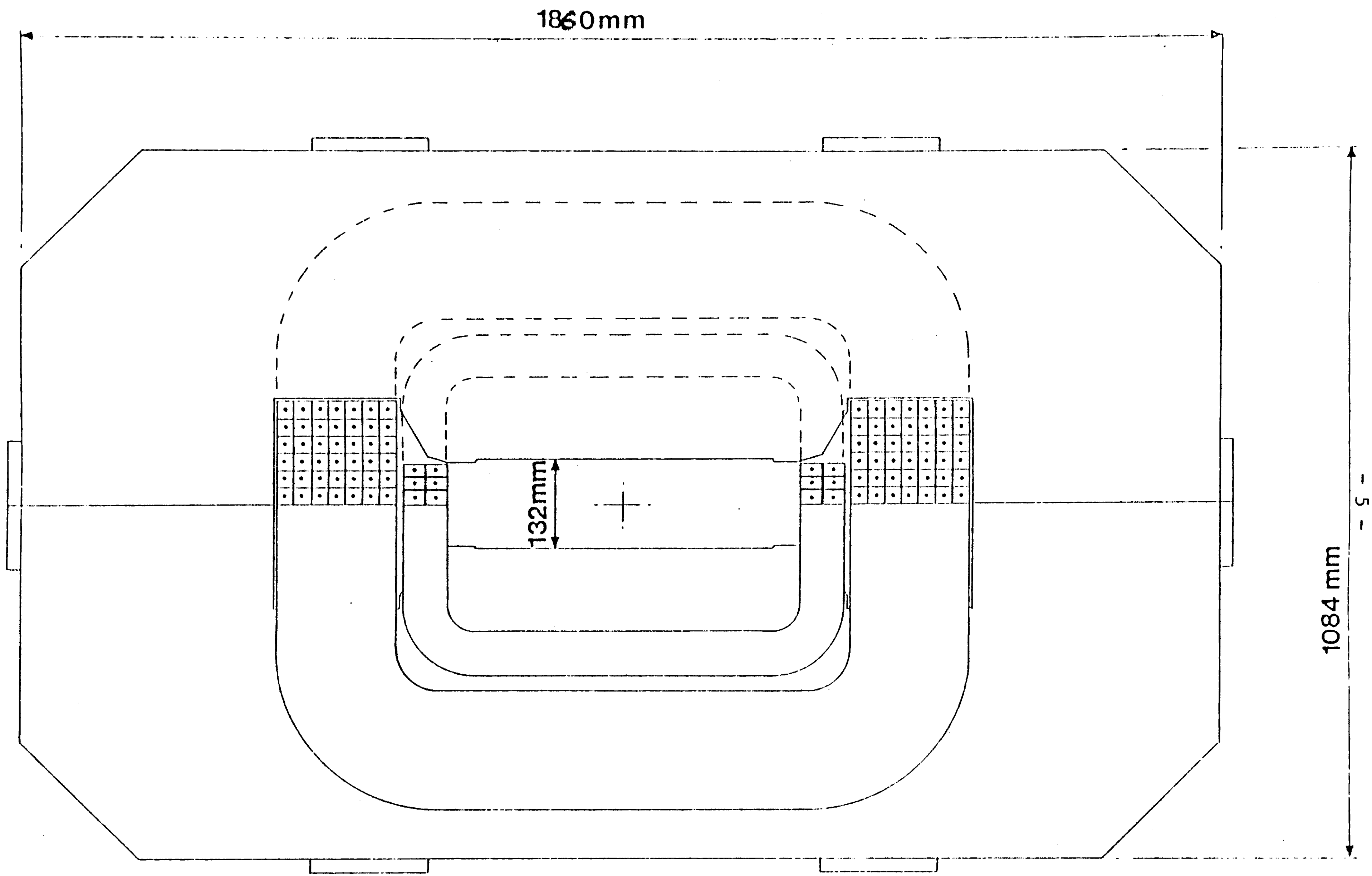
Two-dimensional calculations have confirmed the field quality required in each case ($\Delta g/g \sim 10^{-3}$); future 3-D computations will allow end effects to be accommodated in the lamination profiling. Because of the relatively large length-to-aperture ratio of these magnets, end effects will be much smaller than for the AA quadrupoles, but a sextupole term will again be included so that there will be a left-right assymetry. Provision will be made for shimming the quadrupole ends so that higher-order field components may be incorporated at the measurement stage.

TABLE I

Dipole

Number	24		
Field	1.6T		
Eff length	1.9513 m		
Core length	1.820 m		
Gap height	132 mm		
Overall length	2204 mm		
Overall width	1900 mm		
Overall height	1084 mm		
Good field width	± 197 mm		
Good field height	± 58 mm		
Nominal current	1838 A		
Nominal power	71 kW		
Coil 1 (2 off) turns	42	Coil 2 (1 off)	12
Conductor sections	24 x 24 mm^2		28 x 19 mm^2
Current density	3.42 A/mm^2		3.81 A/mm^2
Hole diameter	7 mm		8 mm
Avge length/turn	6.5 m		5.7 m
Temp rise/layer (coil 1)	20^{0}C	/coil 2	20^{0}C
Pressure drop/layer	3.2 Bar	/coil 2	6.4 Bar
Water flow/layer	3.7 l/m	/coil 2	6.2 l/m
Resistance/layer	1.53 mΩ	/coil 2	2.56 mΩ
Total water flow	50.6 l/m		
Total resistance	20.92 mΩ		
Copper weight	2.611 + .293		
Steel weight	24.75 tonnes		

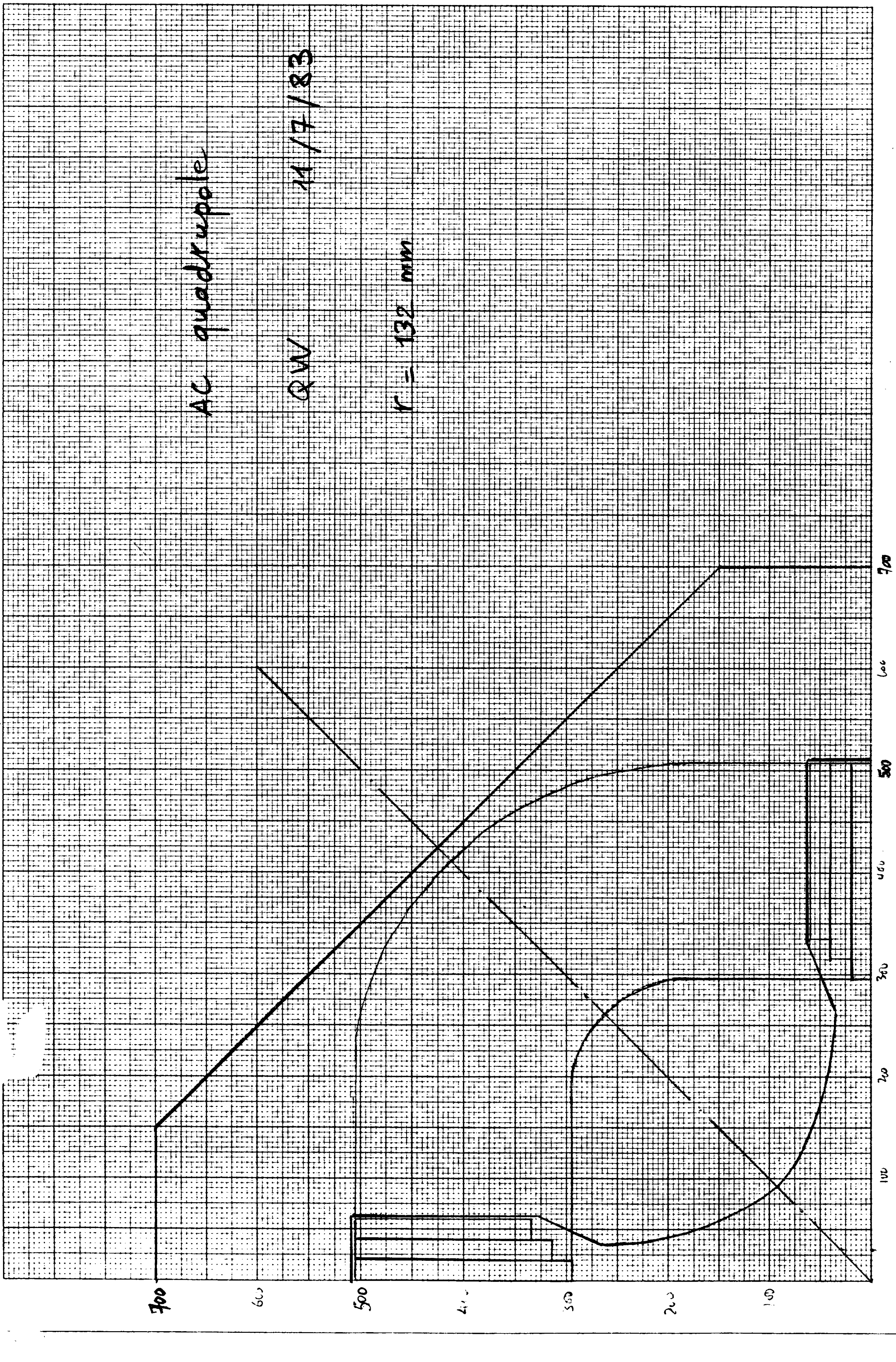

AC dipole
11/7/83
mm
100
270
336
550
700
800
930
1000
mm
600
542
500
400
300
162
66
60



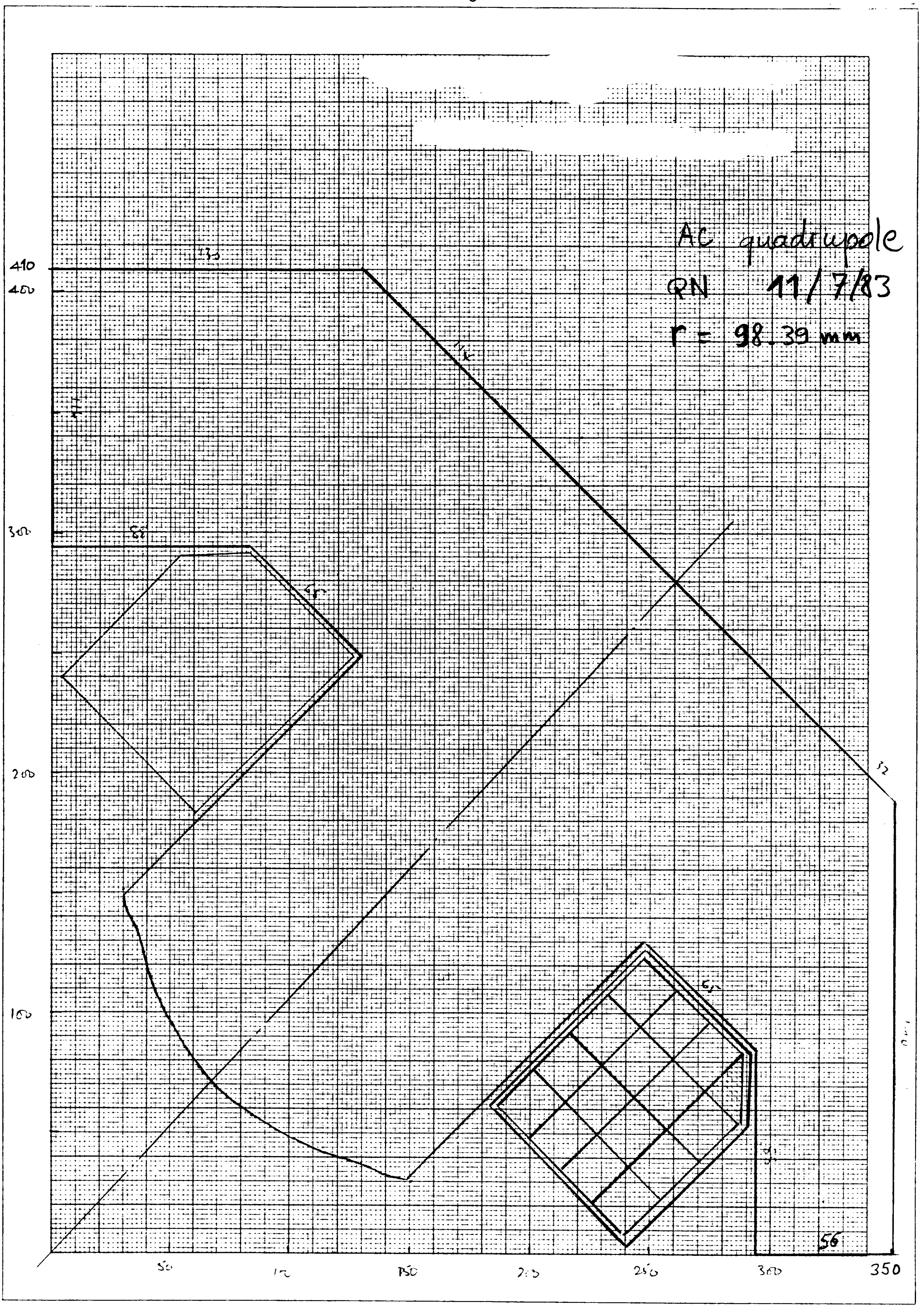
AC DIPOLE

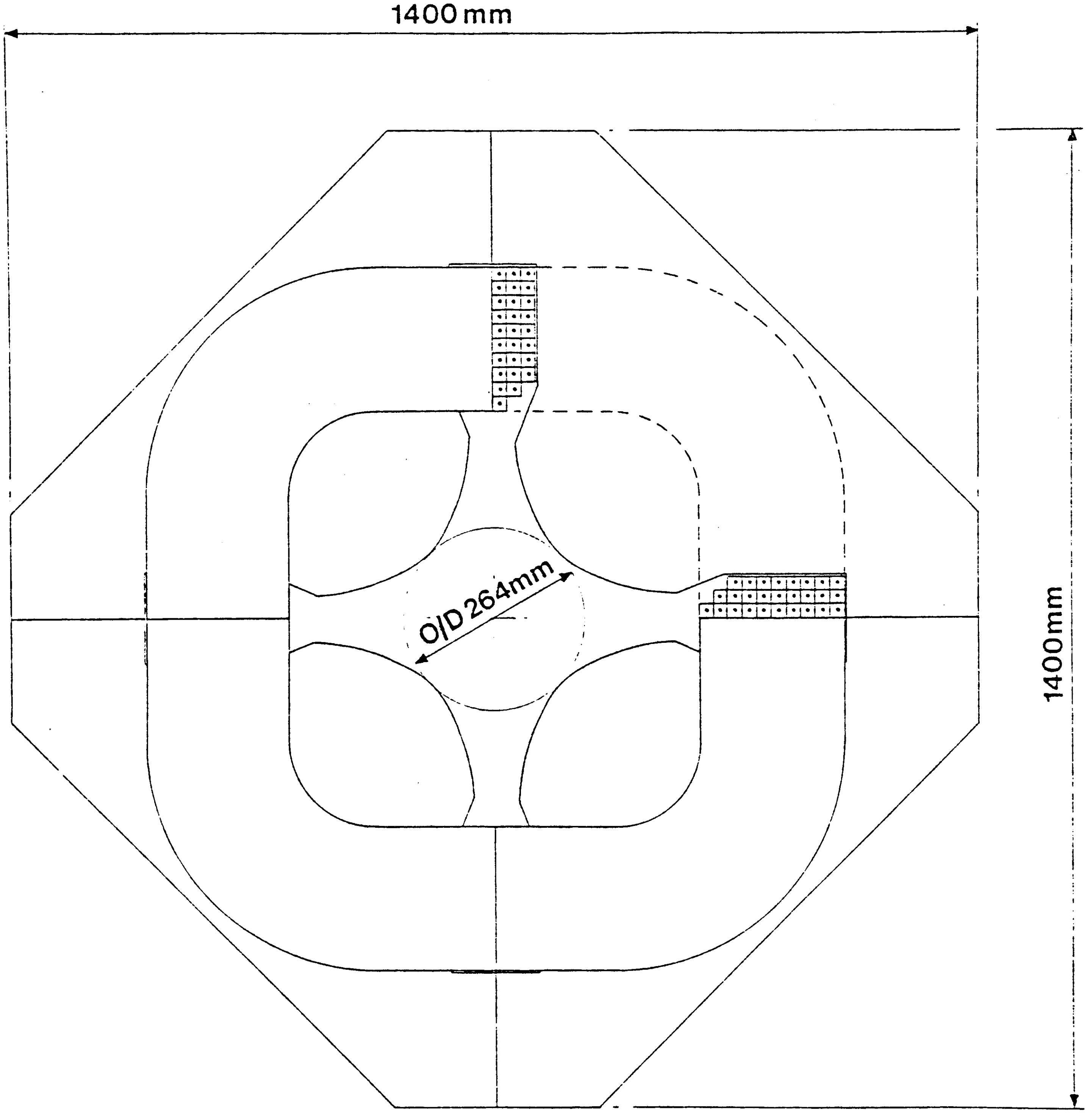
TABLE II

	QW	QN
Number	12	44
Gradient	6.384 T/m	6.384 T/m
Eff length	700 mm	700 mm
Core length	568 mm	618 mm
Inscribed circle radius	132 mm	98.39 mm
Overall length	770 mm	880 mm
Overall width	1500 mm	760 mm
Good field width	± 192 mm	± 87 mm
Good field height	± 64 mm	± 74 mm
Nominal current	1721 A	1721 A
Nominal power	52.5 kW	21.8 kW
Turns/pole	27	15
Conductor cross-section	20 x 17.3 mm^2	20 x 17.3 mm^2
Current density	5.86 A/mm^2	5.86 A/mm^2
Coolant hole diameter	8 mm	8 mm
Average length/turn	2.7 m	2.0 m
Temp rise per coil	30°C	15°C (2 coils in serie will give 30°C)
Pressure drop per coil	6.9 Bar	4.1 Bar
Water flow per quadrupole	25 l/m	10.4 l/m
Resistance per quadrupole	17.7 mΩ	7.36 mΩ
Copper weight	0.76 tonnes	.315 tonnes
Steel weight	5 tonnes	1.66 tonnes

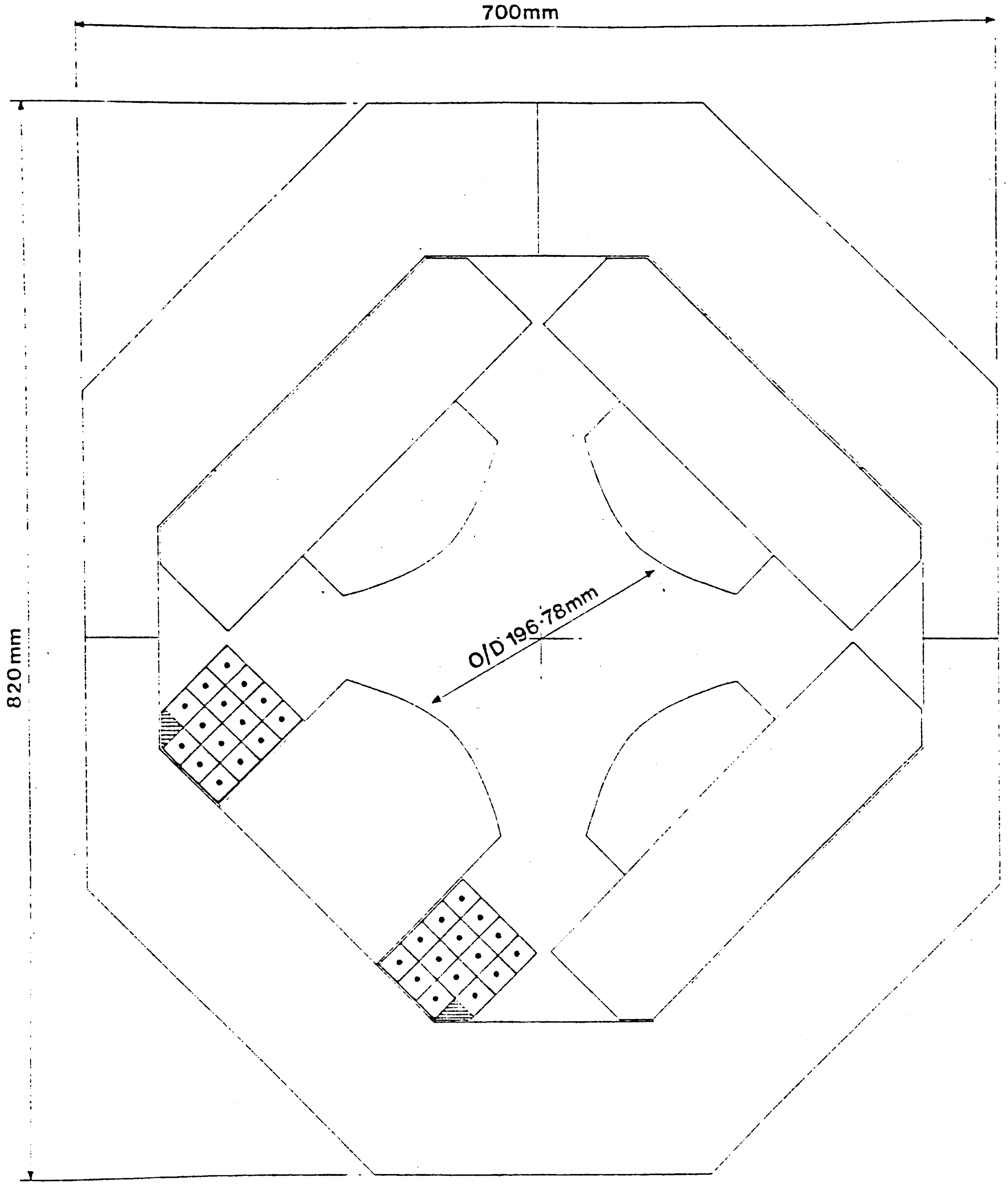


AC quadrupole
QW
11/7/83
r = 132 mm
700
500
300
200
100
700
600
500
400
300
200
100

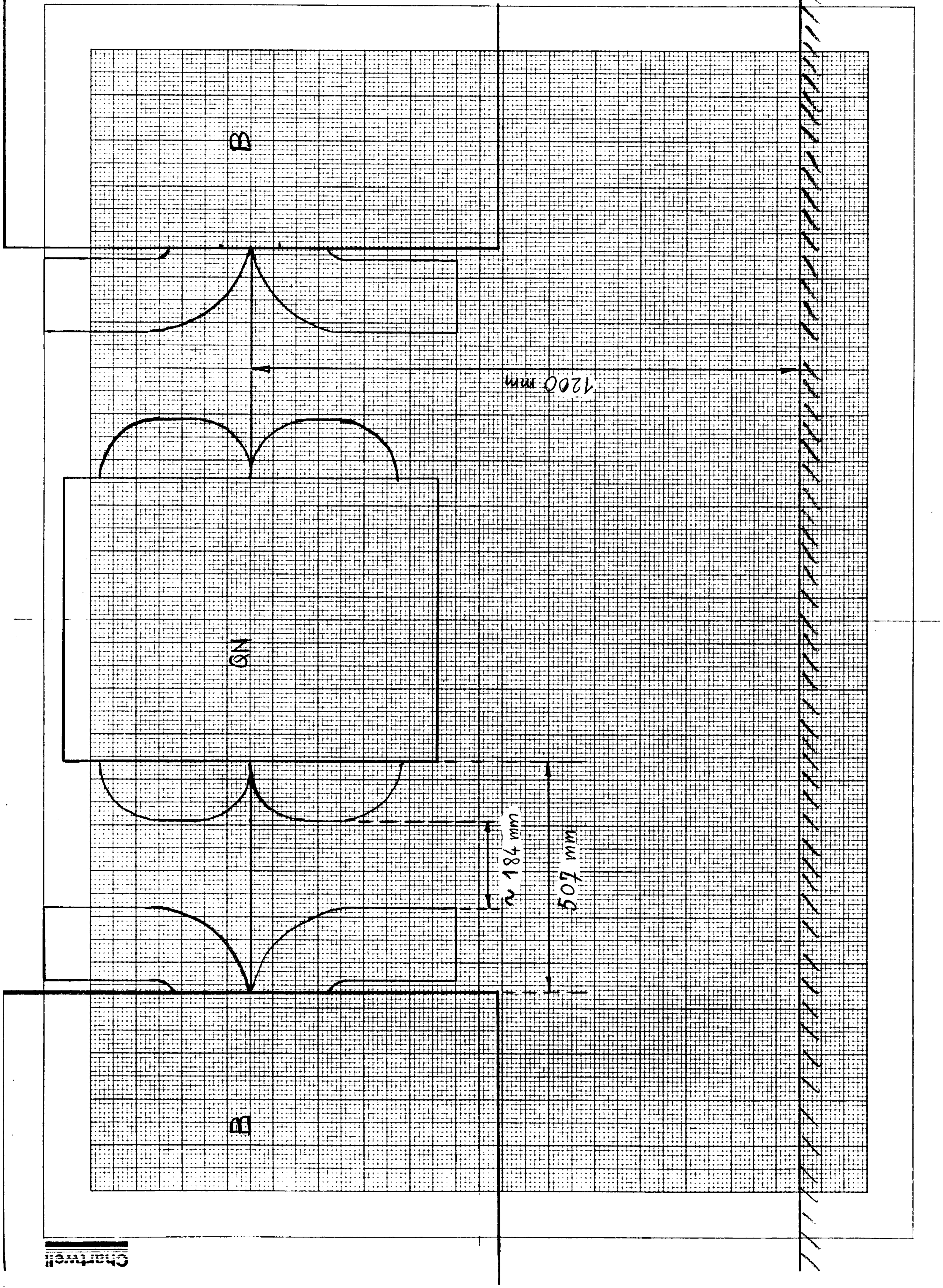

AC quadrupole
RN 11/7/83
r = 98.39 mm
410
56
350



AC QUADRUPOLE QW



AC QUADRUPOLE QN


B
1200 mm
GN
~ 184 mm
507 mm
B

POWER SUPPLIES

The power supplies will be "conventional" dc units from suitable manufacturers experienced in this field. Stability will be better than 1 part in 10^4. Table - lists the parameters.

Table - Magnet Power Supplies

Type	Nominal Output Current A	Nominal Output Voltage V	Nominal dc Power kW	Number
Quadrupole	1721	497	856	2
Dipole	1838	927	1704	1

Power supply for F quads :

$$4\ (\underset{(W)}{2 \times 52.5} + \underset{(N)}{5 \times 21.8}) = 856\ \text{kW}$$

Power supply for D quads :

$$4\ (\underset{(W)}{1 \times 52.5} + \underset{(N)}{6 \times 21.8}) = 733\ \text{kW}$$

VACUUM

Stainless steel vessels with circular end flanges for aluminium diamond seals and V-band couplings are envisaged for all magnets. The chamber cross-sections are tailored to fit the different groups of beam sizes.

Table - details the various parameters. The dipole chambers are assumed straight, not curved to follow the beam.

Table - Parameters of Vacuum Chambers in the Magnets

Magnet	Cross-section, internal width x height or internal diameter x wall thickness mm	Length mm	Flange outer diameter mm	Number
QN	190ø x 3	920	225	40
	174 x 106	920	225	4
QW	254 x 130	810	310	4
	386 x 80	810	420	8
DAC	228 x 112	2250	270	16
	398 x 116	2250	440	8