Fermilab

SSC DETECTOR SOLENOID DESIGN NOTE #103

TITLE: Interim Report on Design of Air Core Solenoid

AUTHOR: T. Kondo

DATE: Dec. 17, 1989

ABSTRACT: This note consists of the viewgraphs presented at the Solenoid Detector Collaboration meeting at Fermilab on December 17 & 18, 1989. It briefly summarizes some conceptual design work done for KEK by Toshiba Corp. Toshiba drawing # OKN-002-265-Rev B is attached.

1989·12·17/18
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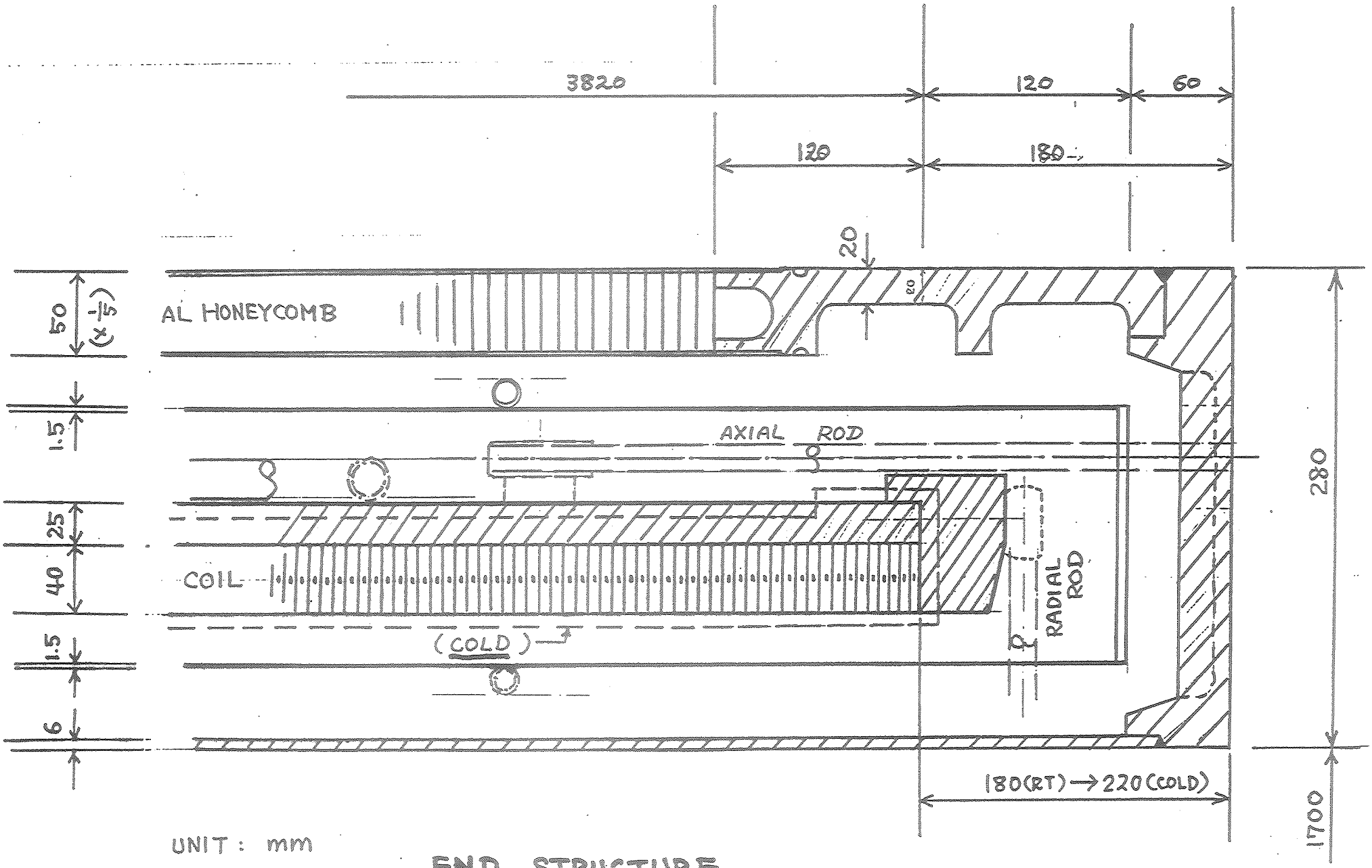
INTERIM REPORT ON DESIGN OF

AIR CORE SOLENOID

1. ENGINEERING DESIGN OF THE END STRUCTURE.

2. GRADED CURRENT DENSITY FOR BETTER FIELD UNIFORMITY

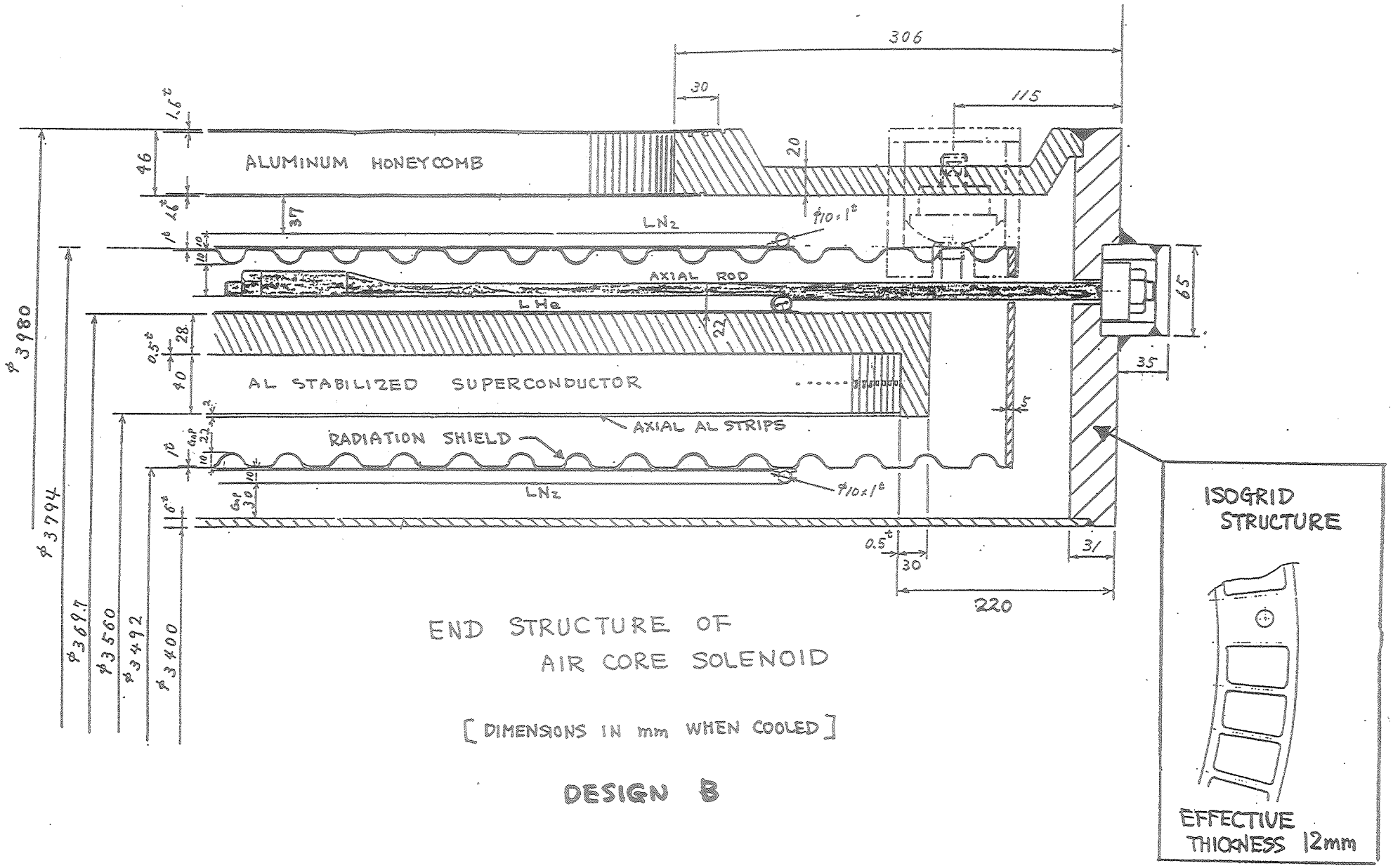
3. FINITE ELEMENT ANALYSIS (SAP, ADINA)



END STRUCTURE

(DESIGN A)

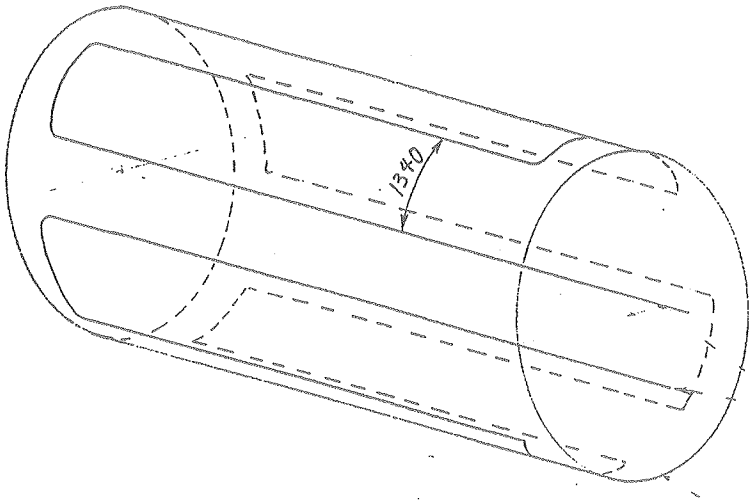
3/3



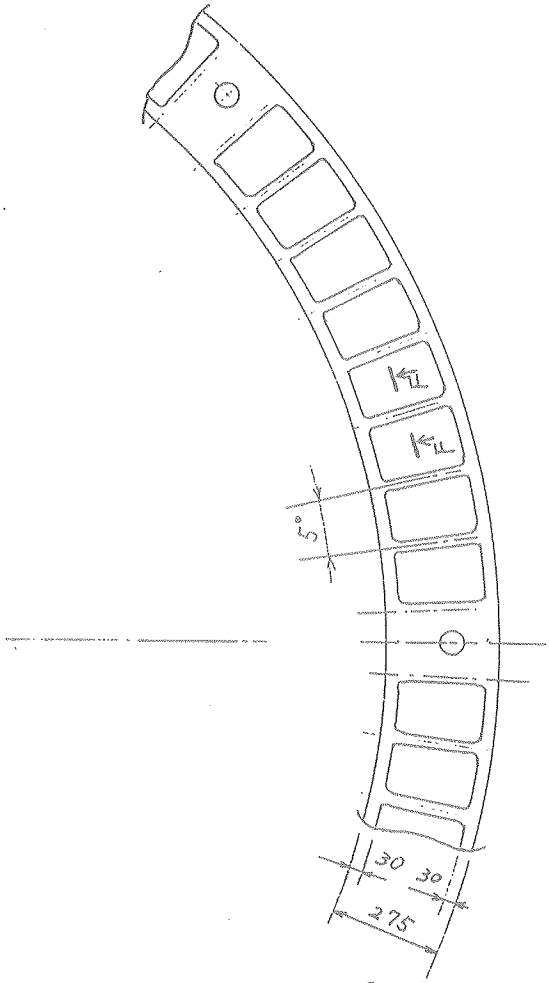
END STRUCTURE OF
AIR CORE SOLENOID

[DIMENSIONS IN mm WHEN COOLED]

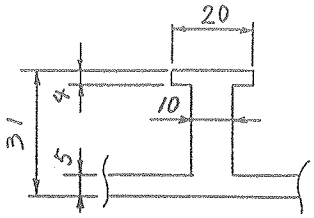
DESIGN B



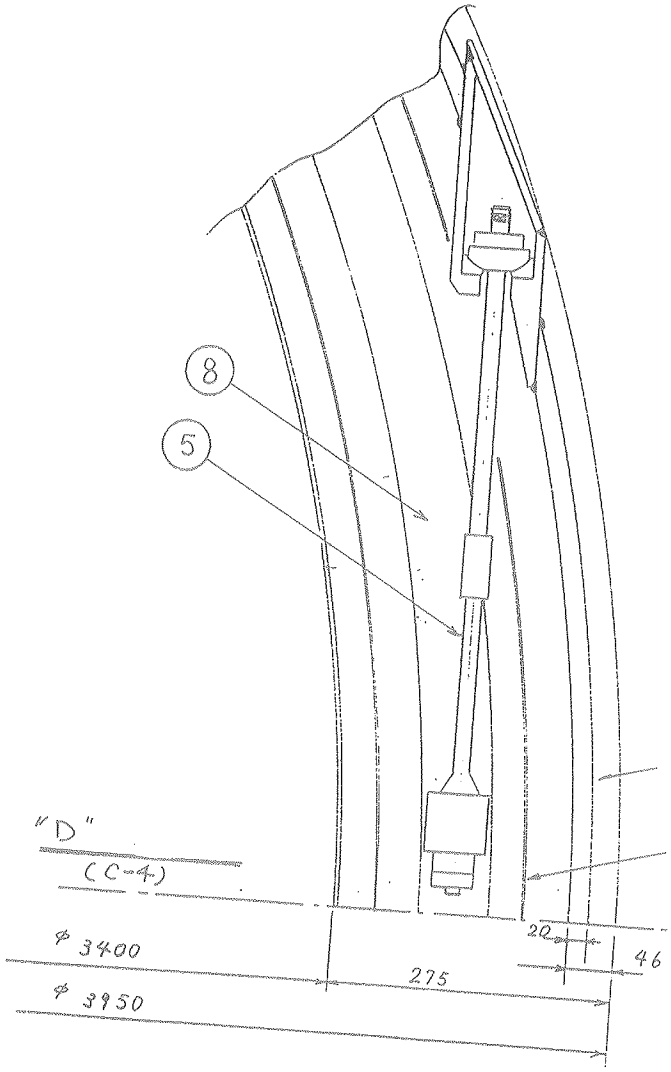
Liq He
cooling pipe



G-G
(B-10)



isogrid endplate

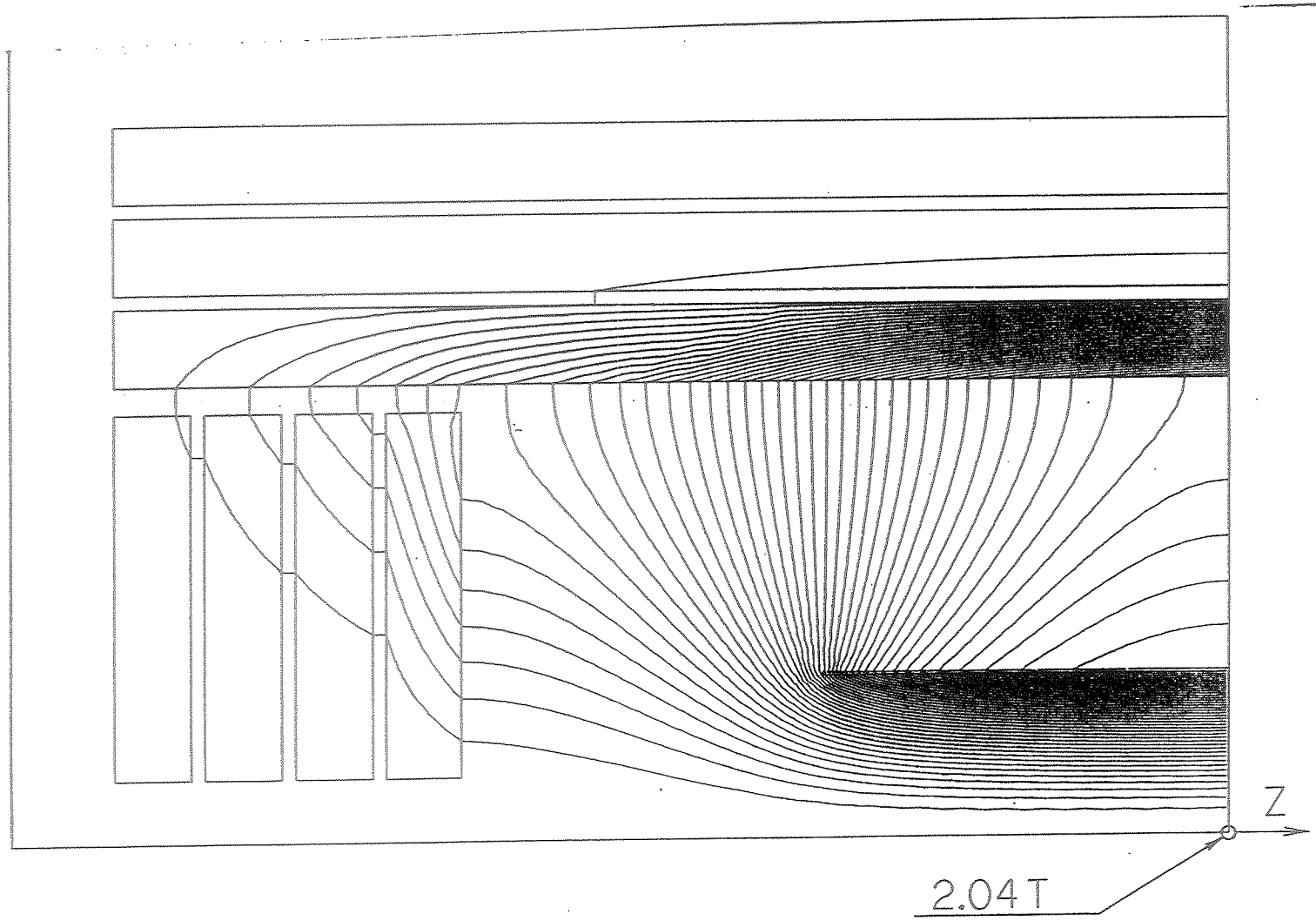


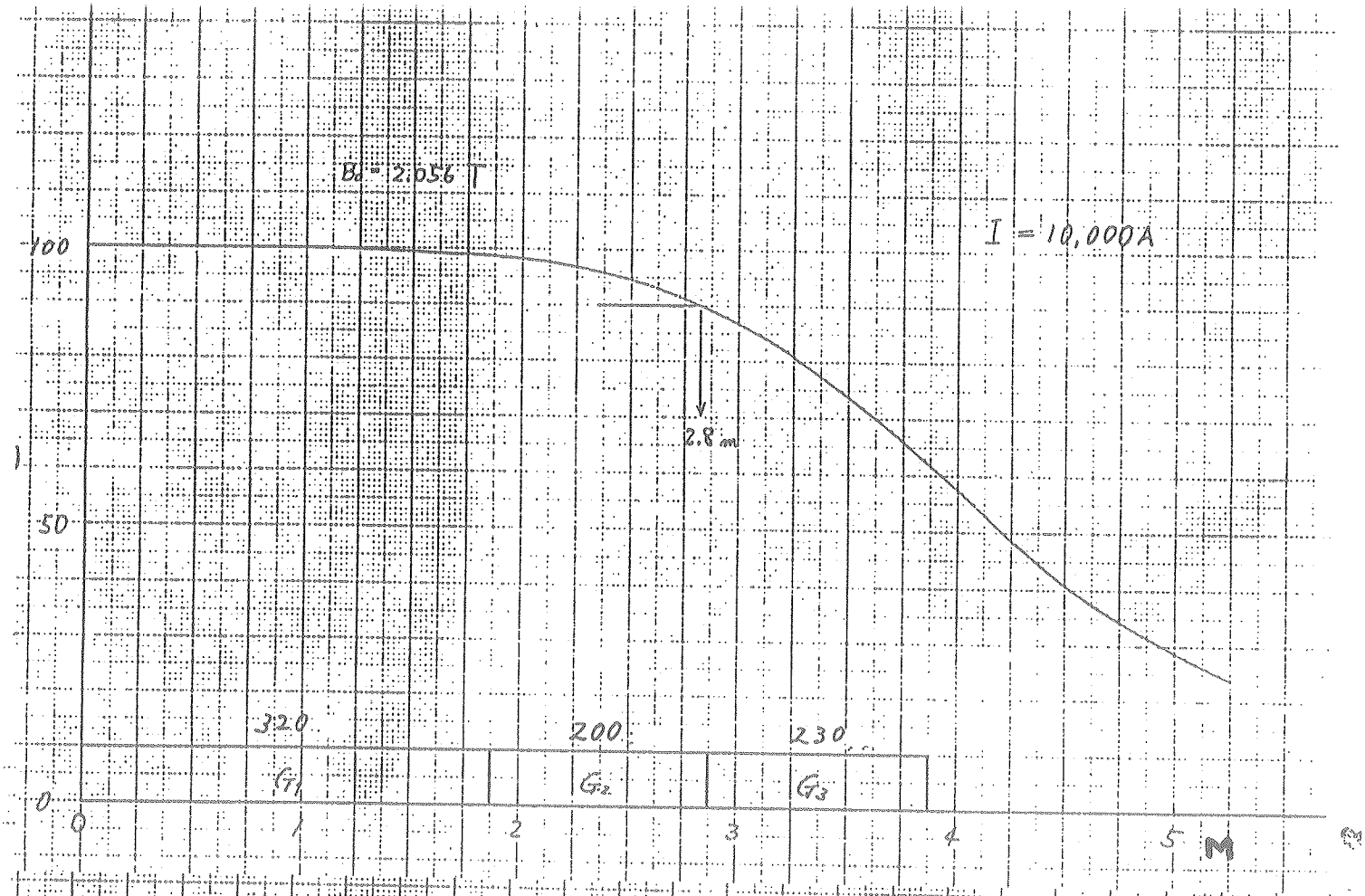
radial support

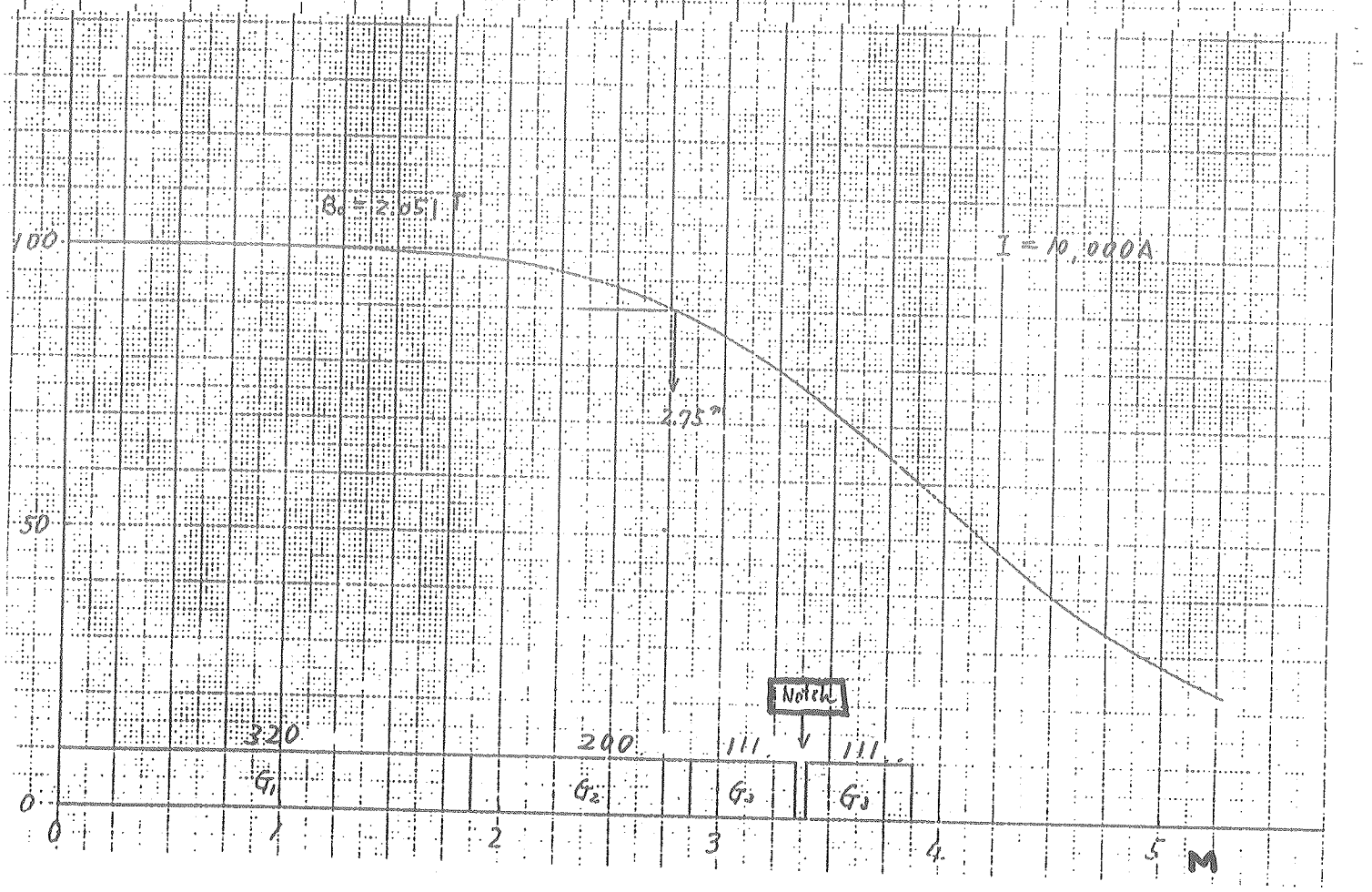
Main Parameters of the Coil

Central field B_{max} (Z=0)		2.05	Tesla
(NI)max		15.0	MAt
Nominal operating current		10,000	A
Stored energy		151	MJ
Self inductance		3.02	H
Radial magnetic pressure (average)		17.9	kgf/cm^2
Axial compression force		1,750	tonf
Number of turns	G1	640	
	G2	200 × 2	
	G3	230 × 2	
E/M		9.6	$\left(\frac{151}{15.8}\right)^{1/3}$

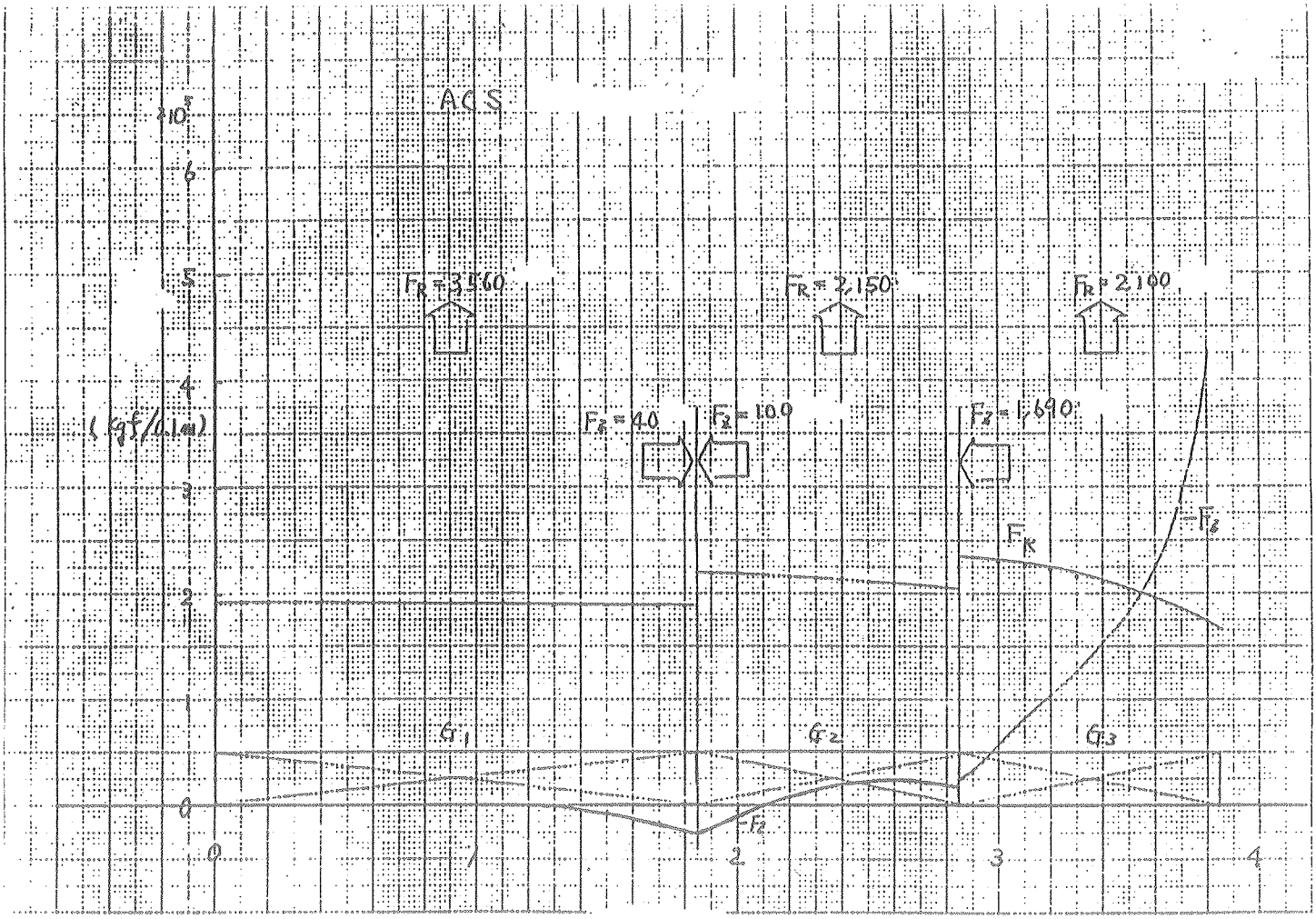
GRADED CURRENT DENSITY

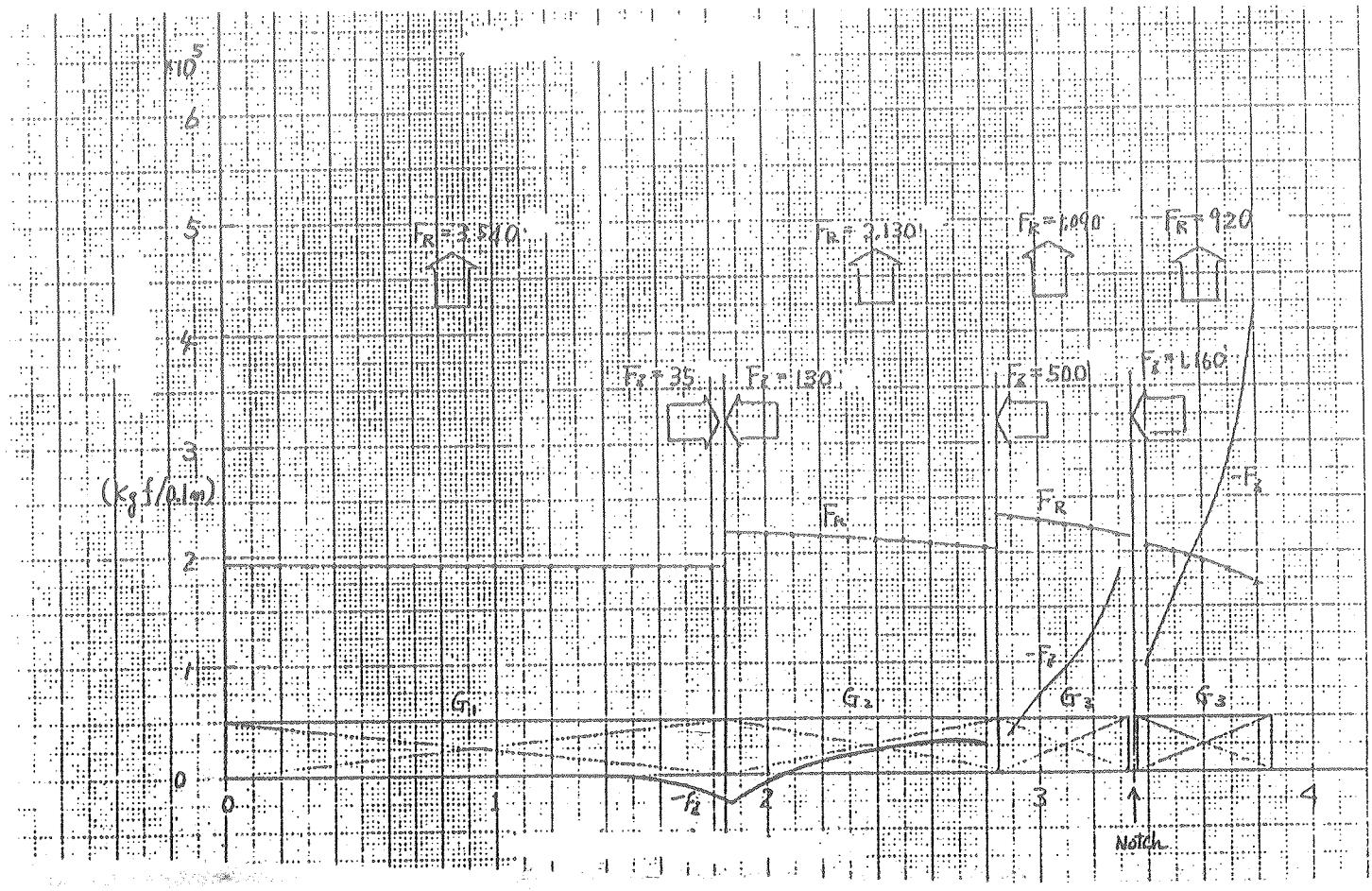

Z
2.04T





FIELD STRENGTH AT r=0

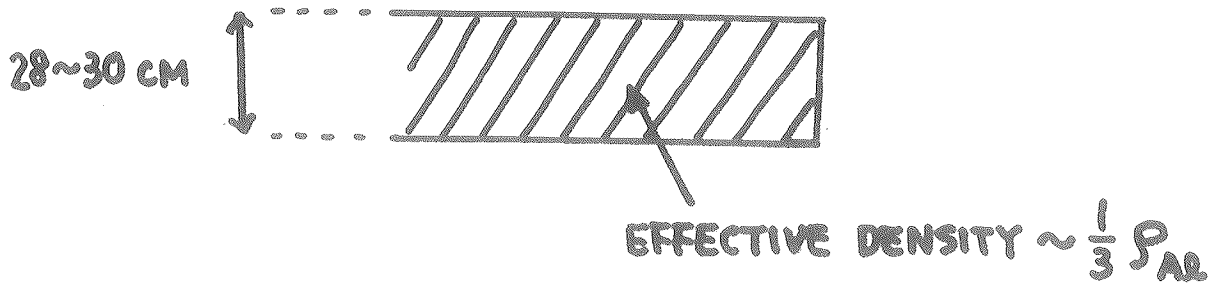

ACS
10^5
6
5
4
3
2
1
0
(kgf/0.1m)
F_R = 3,560
F_R = 2,150
F_R = 2,100
F_z = 40
F_z = 100
F_z = 1,690
F_R
$-F_z$
G_1
G_2
G_3
$-F_z$
0
1
2
3
4


10^5
6
5
4
3
2
1
0
(kgf/0.1m)
F_R = 3,810
F_R = 2,130
F_R = 1,090
F_R = 920
F_z = 35
F_z = 130
F_z = 500
F_z = 1,160
F_R
F_R
F_R
$-F_z$
$-F_z$
$-F_z$
G_1
G_2
G_3
G_3
0
1
2
3
4
Notch

1989·12·17/18

SUMMARY ON AIR CORE SOLENOID

1. THE END STRUCTURE DOES NOT INTRODUCE OVERALL ADDITIONAL RADIATION THICKNESS.



2. RESULTS OF FINITE ELEMENT ANALYSIS

$\sigma_{max} \sim 9.3$ kgf/mm² (Al cylinder)

$2\tau_{max} \sim 12.9$ kgf/mm² (Al cylinder)

τ_{yz} (epoxy) < 0.21 kgf/mm²

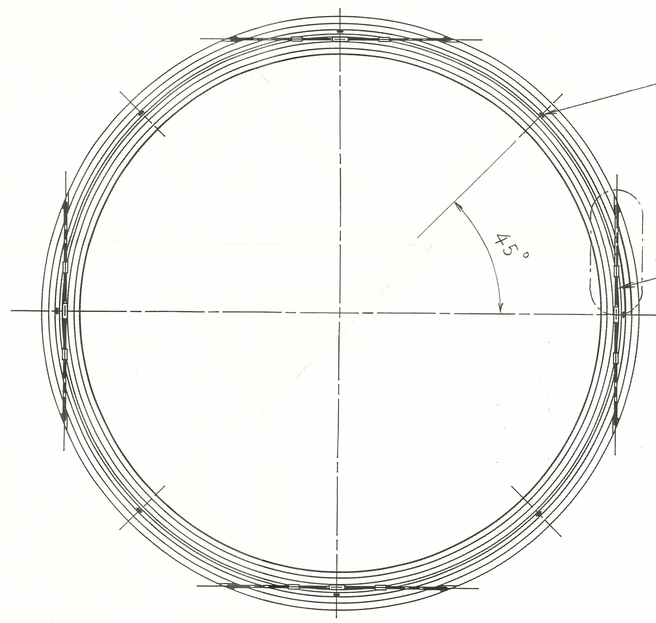
$\Delta z_{max} \sim 3.4$ mm

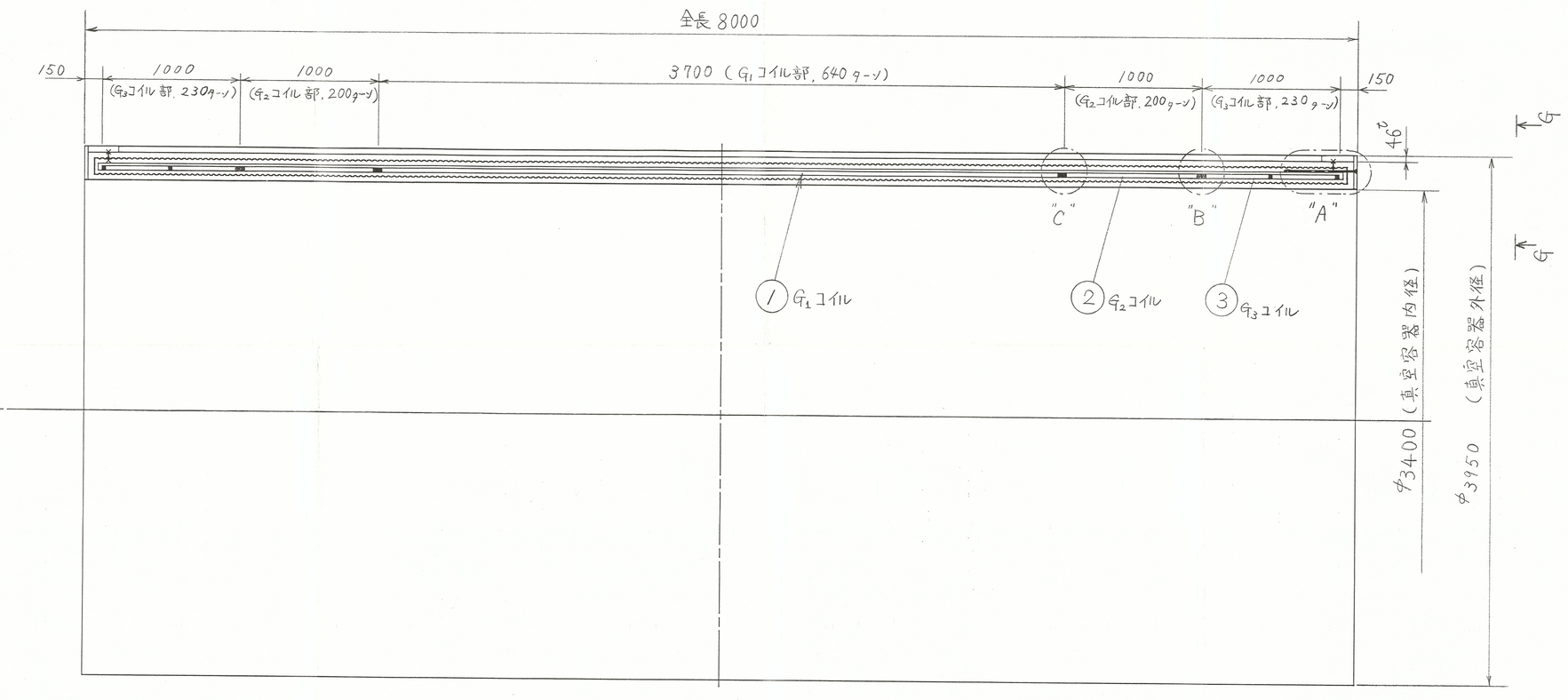
$\Delta r_{max} \sim 2.6$ mm

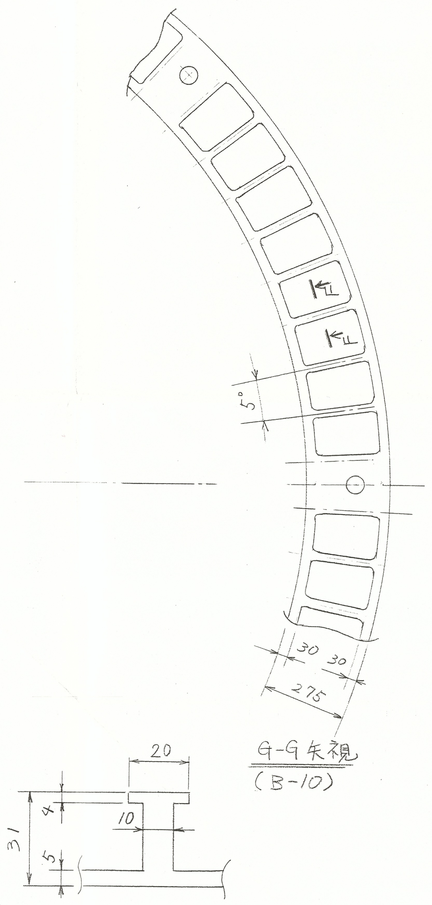
WITH GRADED WINDING.

C/H 図面番号 DRAWING NO. F1 0 KN000265 | 実験機名 名称 TITLE (ABBR.) BD ウスニク ソレノイド | MODEL CODE KE＊＊＊ | 品質管理 REMARKS | 様式 FREQ. DL3 | M.F. 1 | 普通計容器パト配ニヨル

図面番号 DRAWING NO. 0 KN000265 | 改訂番号 REV. MARK B

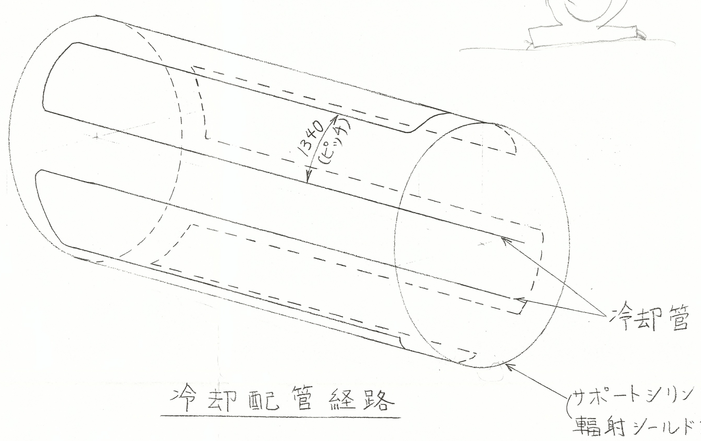




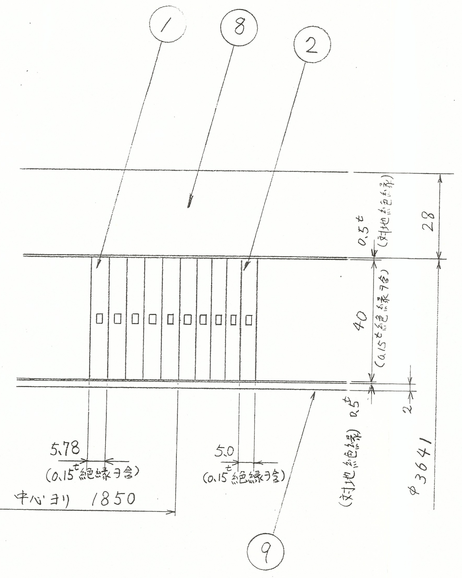


G-G 矢視
(B-10)

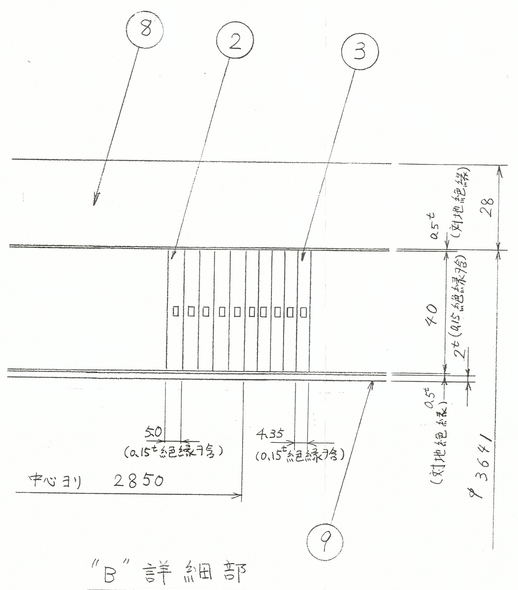
F-F 断面
(C-12)



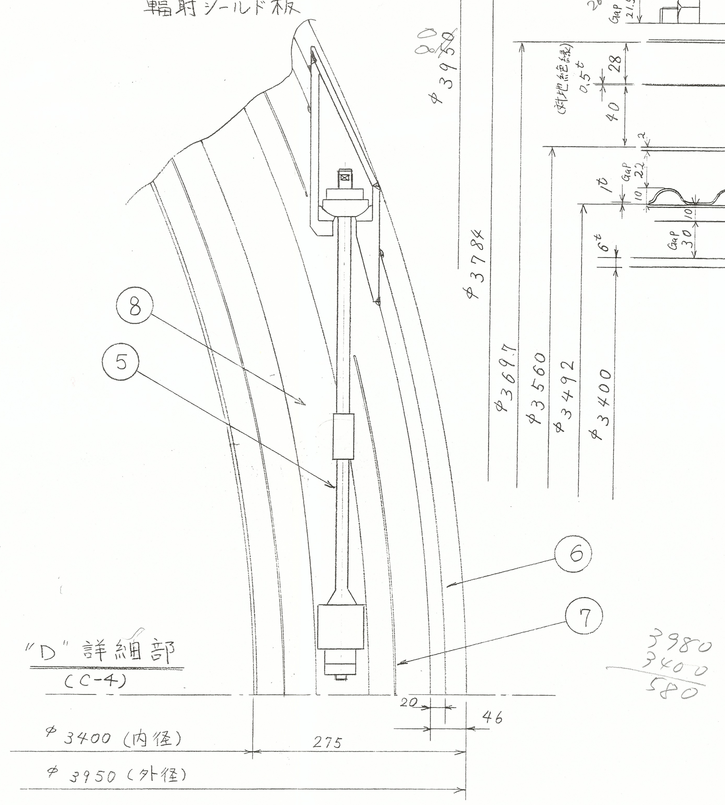
冷却配管経路



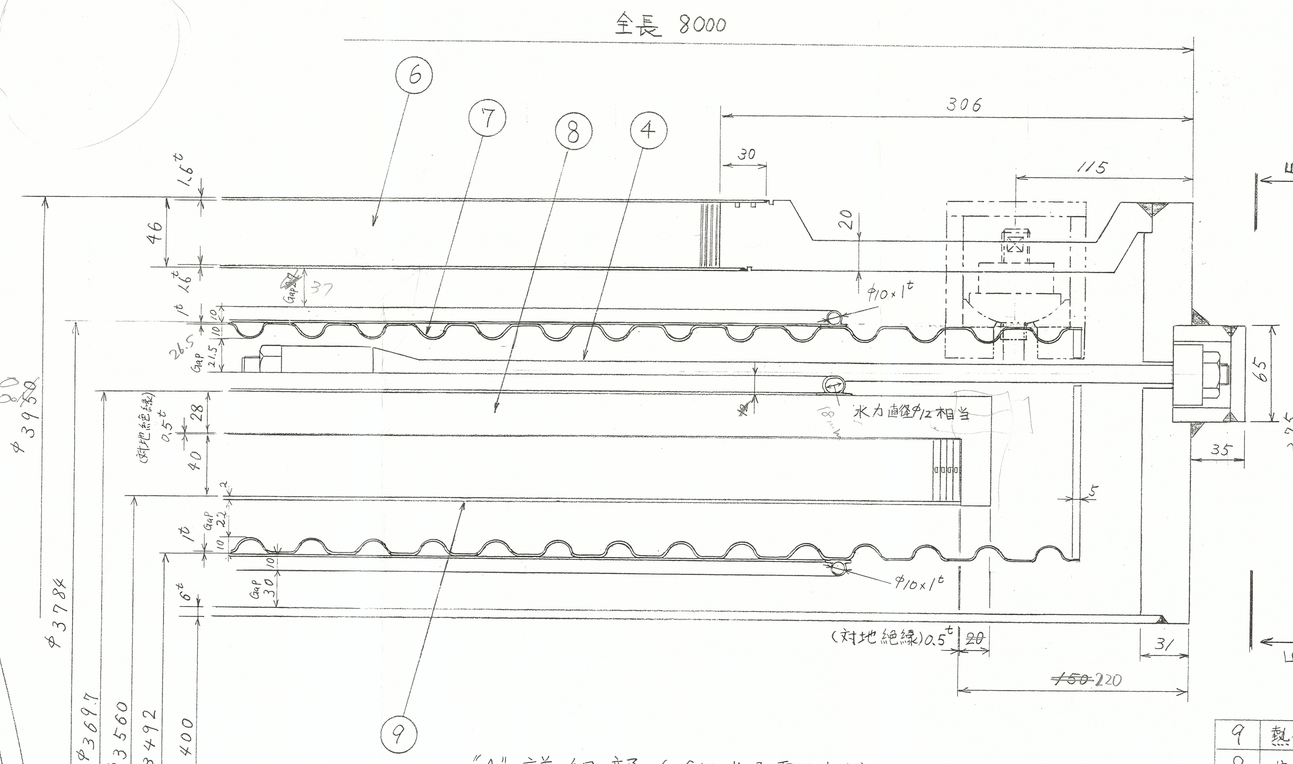
"C" 詳細部
(B-9)



"B" 詳細部
(B-9)

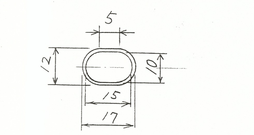


"D" 詳細部
(C-4)



"A" 詳細部 (冷却・非通電時寸法)
(B-10)

E-E 矢視



サポートシリンダー用冷却パイプ

P.No.	部品名称	材質	数量	備考
9	熱伝導用アルミ板	A1N99	1式	2°, 99.999%純アルミ
8	サポートシリンダー	A 6061T6	1式	冷却パイプ付
7	輻射シールド板	A1050	1式	1°, φ10×1°冷却パイプ付
6	真空容器外筒	A5052	1式	ハニカム構造
5	周方向サポート	CFRPφ15×2.5	16式	水平方向φ12, 垂直方向φ5
4	軸方向サポート	CFRP	8式	φ12
3	ソレノイドコイル (G3)	Nb-Ti/Cu/Al	2式	39.7×4.05°, 230ターン×2
2	ソレノイドコイル (G2)	Nb-Ti/Cu/Al	2式	39.7×4.7°, 200ターン×2
1	ソレノイドコイル (G1)	Nb-Ti/Cu/Al	1式	39.7×5.48°, 640ターン

承認 APPROVED BY	調査 REVIEWED BY	名称 TITLE	
宮崎 89-12-11	佐藤 89.11.29	大型空心薄肉ソレノイド	
調査 REVIEWED BY	担当 PREPARED BY		
三橋 89-12-11	三見 89.11.28	高エネルギー物理学研究所殿	
担当 PREPARED BY			
木村 89.11.28			

尺度 SCALE 1/1 | 単位 UNITS mm | 数量 | REV. 記号 | 全面書換 | 記事 CONTENTS

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図面番号 DRAWING NO. 0 KN000265 | 改訂番号 REV. MARK B

保管 REGISTERED | 配布先 PRESENT TO