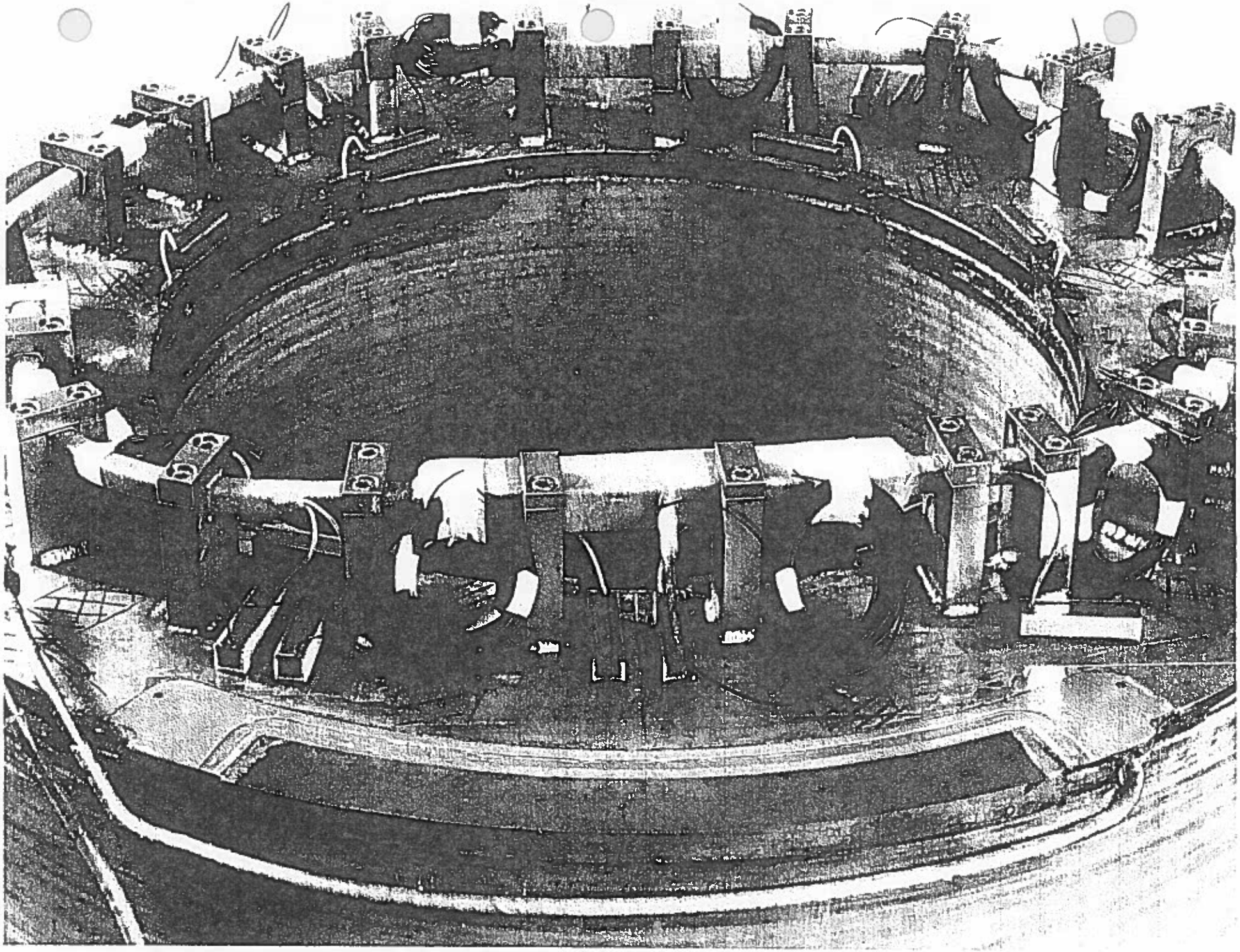
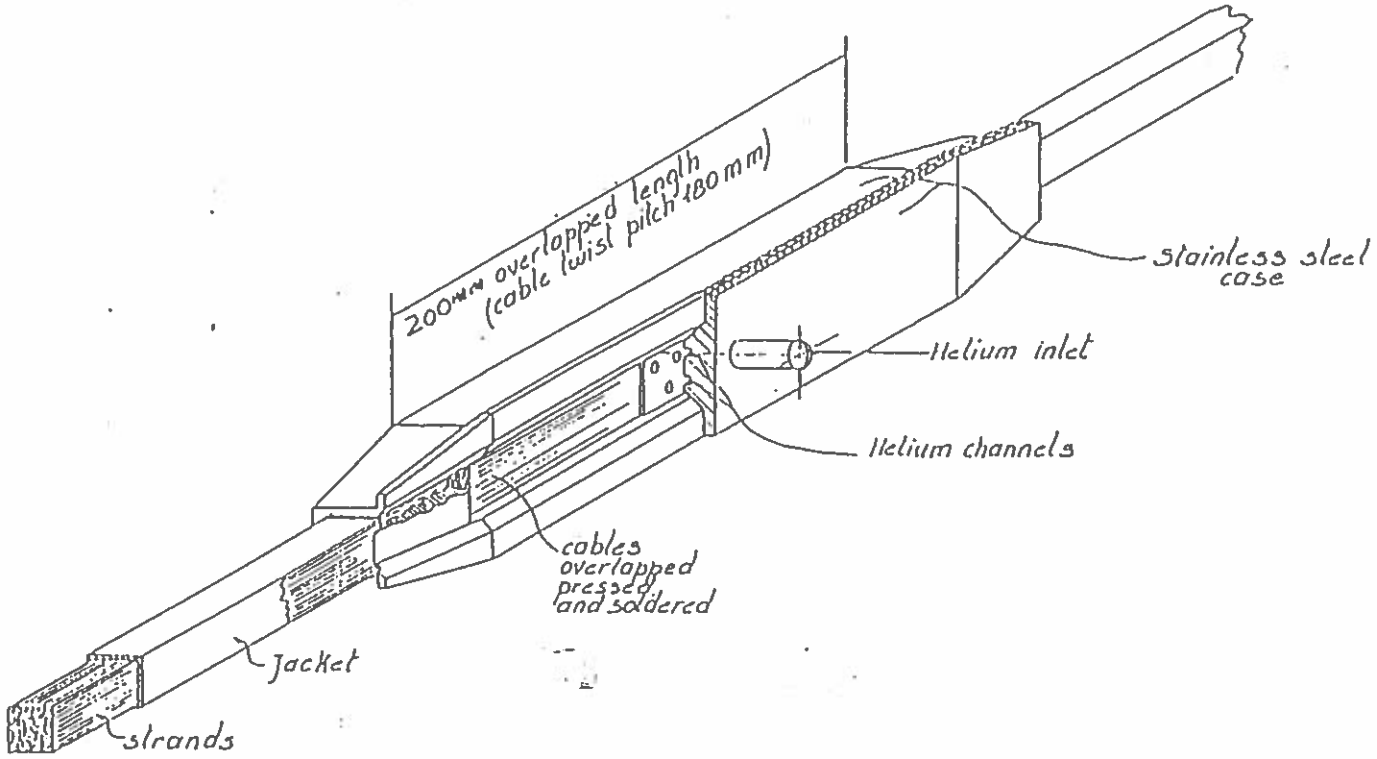
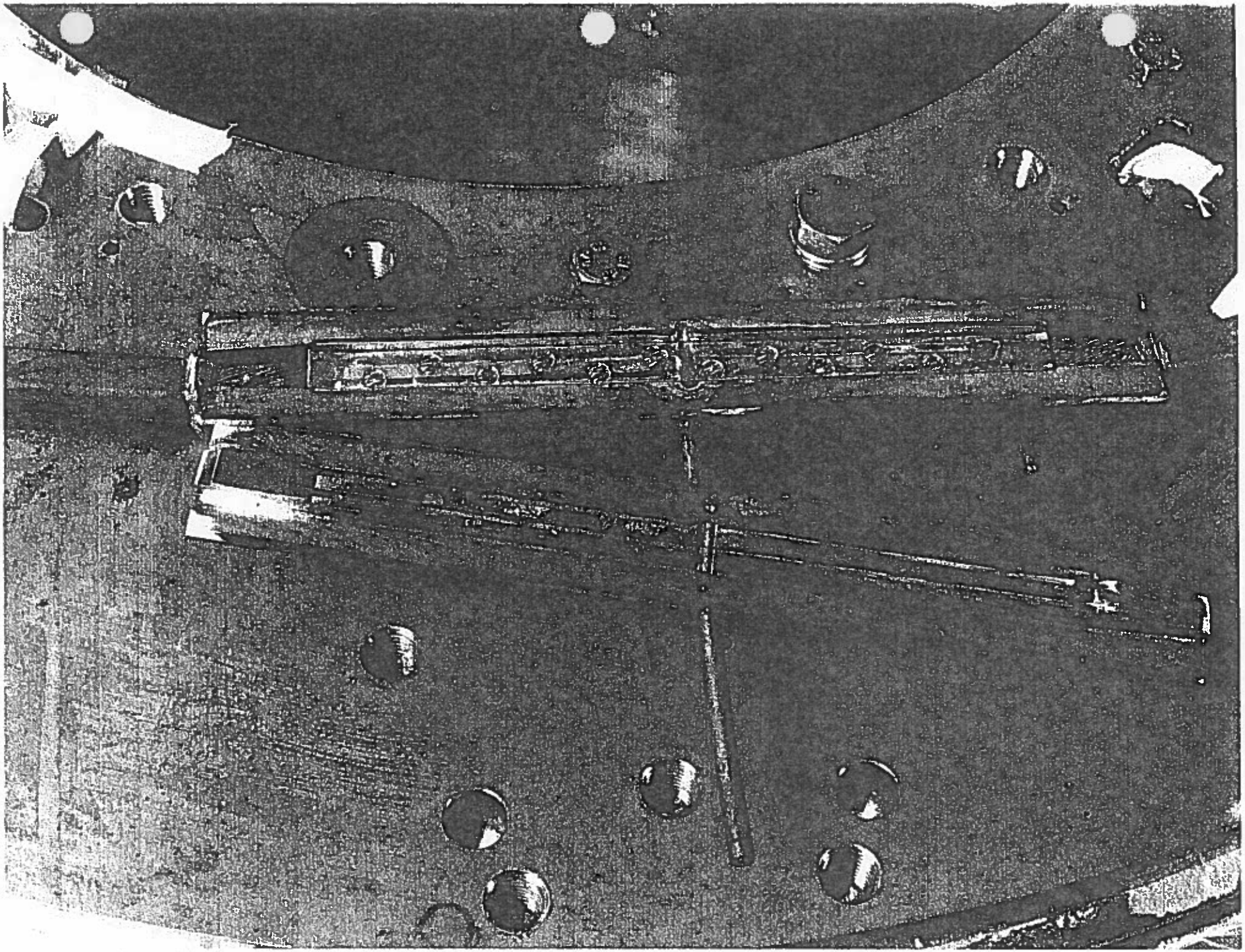


A PARTICULAR OF THE COIL. The 2 interlayer joints and one terminations are visible.



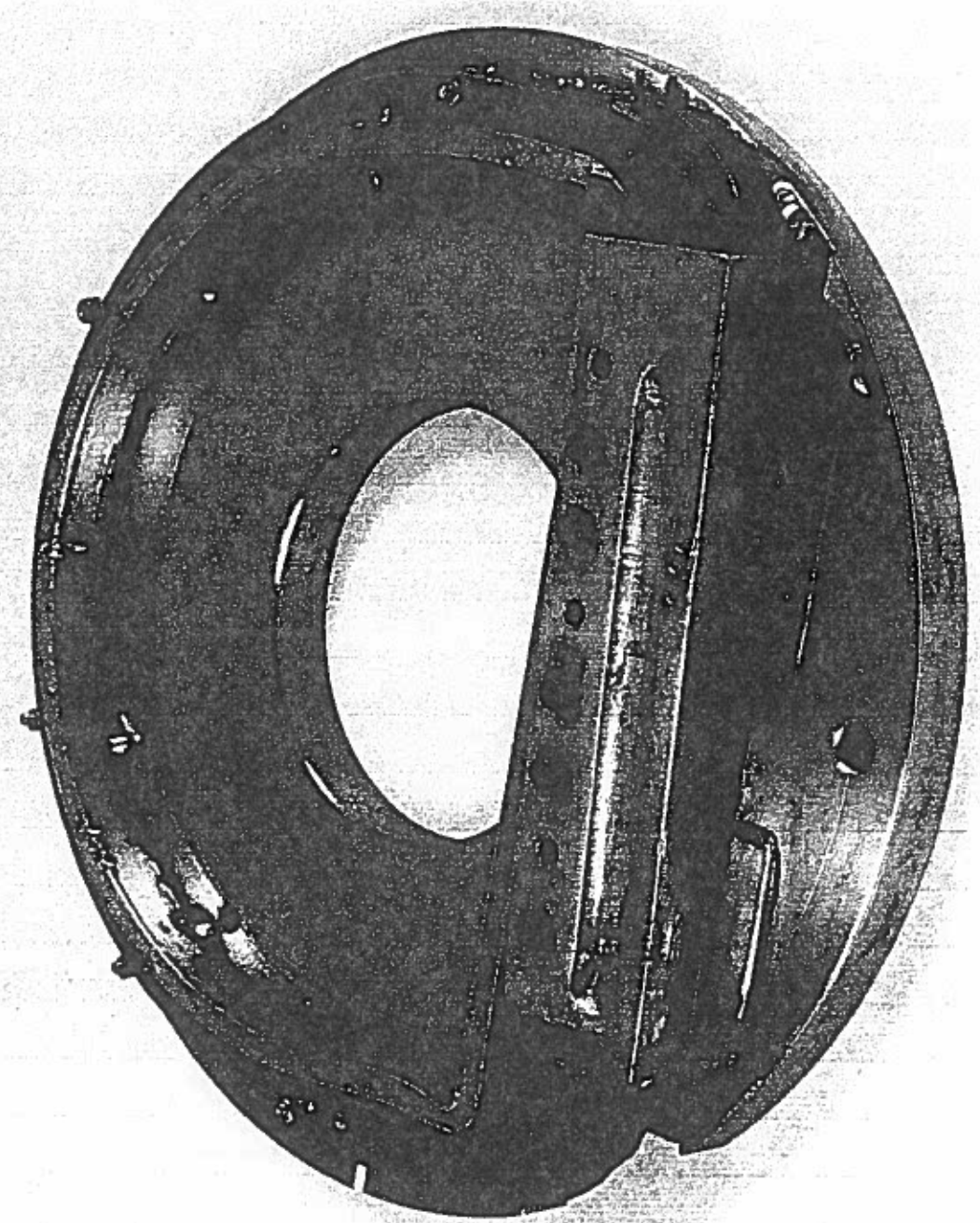
12 T SOLENOID INTERLAYER JOINT DESIGN

ANSALDO
Componenti



One of the 2 interlayer joint of the final coil after the heat treatment

THE SAMPLE USED TO TEST THE COIL TERMINATION PROTOTYPES.

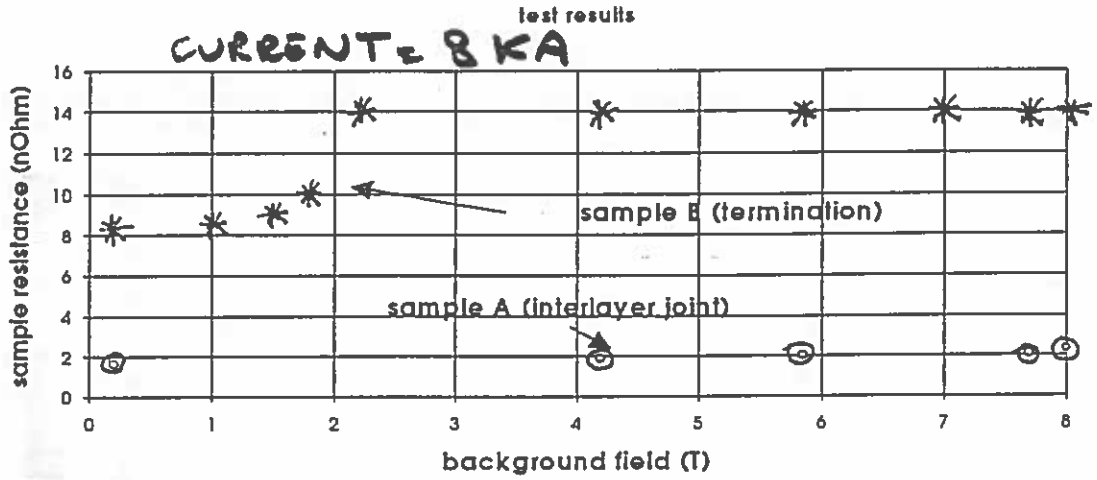


TESTS RESULTS :

The tests have been carried out at INFN laboratory in Genova

SAMPLE A : INTERLAYER JOINT PROTOTYPE 140 mm LONG (real joint 200 mm)

SAMPLE B :2 TERMINATION PROTOTYPES 120 mm LONG (real termination 380 mm) JOINED TOGETHER WITH INDIUM SOLDER



EXTRAPOLATED VALUES FOR THE REAL LENGTHS:

INTERLAYER JOINT : $R < 2n\Omega$ at 10 T

TERMINATIONS JOINT: $R < 4n\Omega$ at 8 T

BOTH THE VALUES FIT THE SPECIFICATION RELATED TO THE MAXIMUM POWER ALLOWED.

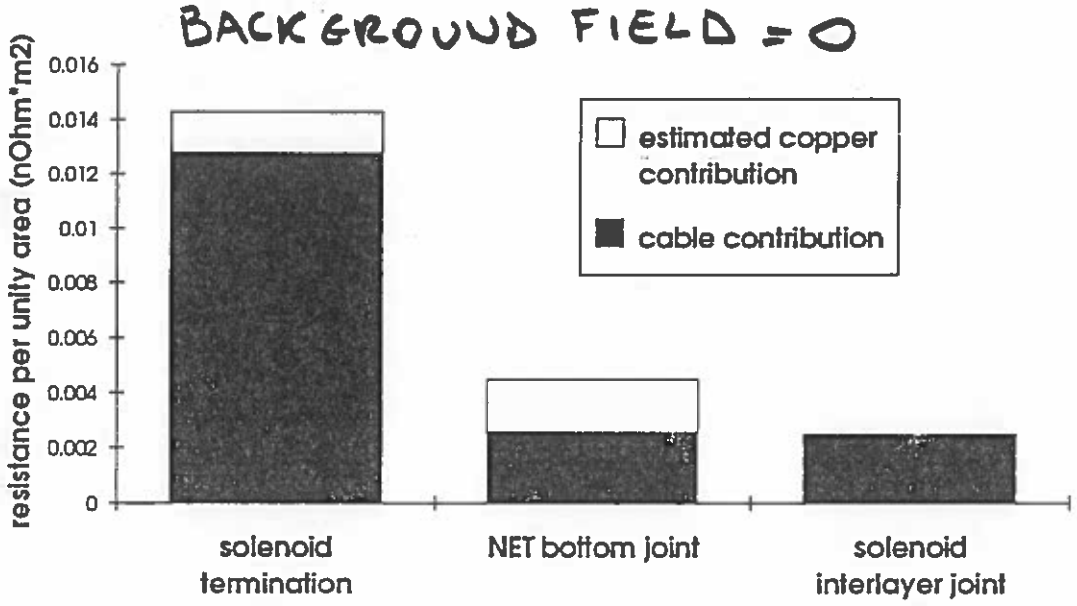
REMARK :

THE JOINTS TESTED WERE SHORTER THAN THE LAST STAGE CABLE TWIST PITCH (180 mm) .

COMPARISON BETWEEN DIFFERENT JOINT DESIGNS :

USED PARAMETER :

$R \cdot A$ = MEASURED RESISTANCE TIMES THE AREA OF CONTACT SURFACE .



tested joints main characteristics

joint type	compacting factor (% voids)	length/Lp	copper thickness between cables (mm)
NET term.	10-15	1.18	10
12 T term.prot.	30	.67	9 (mean value)
12 T int. joint prot.	10-15	.78	0

Model coil experience

THE SCOPE WAS TO TEST ON A REAL COIL THE EFFICIENCY OF THE MANUFACTURING OPTIONS SELECTED.
IN PARTICULAR :

- **THE EFFECT ON THE INSULATION OF THE HIGH RADIAL WINDING PRESSURE.**

- **THE EFFICIENCY OF THE DESIZING TECHNIQUE ON A REAL WINDING.**

- **THE EFFICIENCY OF THE MICA PAPER AS MOLD RELEASE AGENT.**

COMPARISON BETWEEN MODEL AND REAL COIL MAIN CHARACTERISTICS:

	MODEL COIL	*REAL COIL*
INNER DIAMETER	604 mm	604 mm
NUMBER OF LAYER	3	13
n TURN/LAYER	7	22
CABLE INSULATION THICKNESS	.75 mm	.75mm
LAYER INSULATION THICKNESS	.4 mm	.4 mm
CONDUCTOR DIMENSIONS	13.8*13 .8 mm^2	13.8*13.8mm^2

TESTS CARRIED OUT ON THE MODEL COIL:

- COOL DOWN TO 77 K

- PRESSURE DROP MEASUREMENTS AT R.T AND 77 K

- INSULATION ELECTRIC TESTS AT R.T. AND 77 K

- PRESSURE LEAK TEST ON THE COIL AT R.T. AND 77 K

- WINDING DISSECTION AND VISUAL INSPECTION

NOTE : NO CURRENT TESTS!

ELECTRIC INSULATION TESTS ON THE MODEL COIL

a) pulse test at R.T. and 77 K

Voltage pulses up to **1600 V** (corresponding at **1 KV between layers** and **75 V between turns**) have been applied at the ends of the coil

No shorts have been detected

b) D.C. ground insulation tests at R.T.

An aluminum sheet has been wrapped around the coil and a voltage up to **5 KV** has been applied **between coil and sheet.**

No shorts have been detected

A ground insulation of 230 MOhm has been measured.

It corresponds to 140 MΩ per square meter of external coil surface.

CONCLUSION:

The quality of the insulation is not affected by the winding pressure, the heat treatment and the mandrel removing operation.

The desizing technique developed by Ansaldo is efficient also in a real coil.

FINAL COIL CONSTRUCTION STEPS FOLLOWED:

(started December 92 - ended may 93)

STEP		DURATION
- WINDING		3 months
- HEAT TREATMENT		6 weeks
- JOINTS SOLDERING		2 weeks
- IMPREGNATION		3 weeks
total time	≈	6 months

ROOM TEMPERATURE INSULATION TESTS CARRIED ON THE COIL :

a) pulse insulation tests:

Pulses up to 1.5 KV have been applied to the coil.

No shorts have been detected.

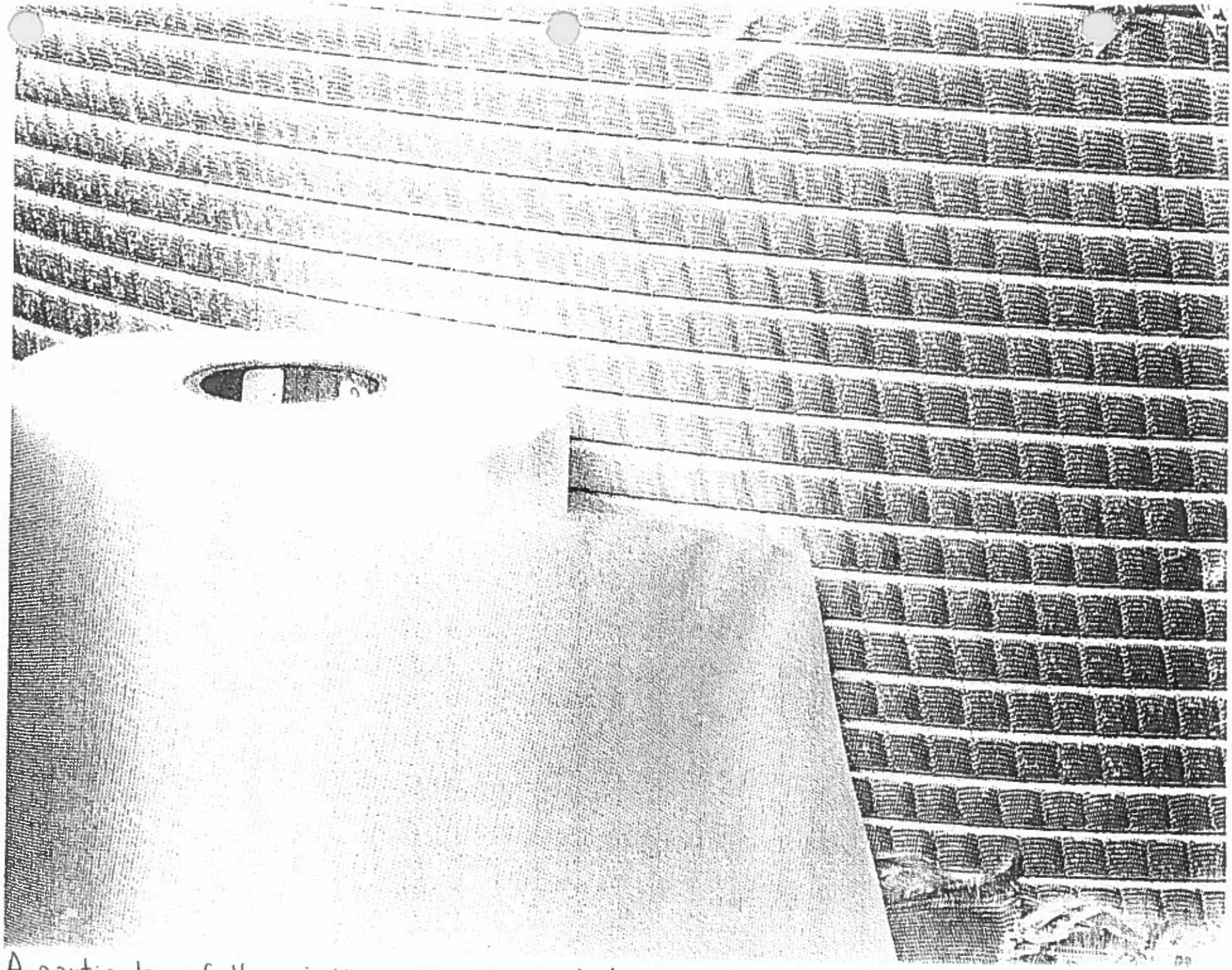
b) D.C. insulation tests

A d.c. voltage up to 2 KV has been applied between the coil and the aluminum sheet wrapped on the coil.

No shorts have been detected.

The resistance between coil and aluminum is 60 MOhm corresponding to 162 MOhm per square meter of external coil surface.

A value slightly better than in the model coil !



A particular of the winding after the heat treatment. A not heat treated glass tape is shown for comparison.

12 T SOLENOID FUTURE TESTS:

- LN_2 TEST AT ANSALDO

- A.C. AND D.C. TESTS AT ENEA LABORATORY (FRASCATI)

The coil will be tested in a background field coils system.
The maximum field in test conditions will be between 8 T and 9 T.
The tests will be carried out at different current and field ramp rates.