ANSALDO EXPERIENCE IN CICC DEVELOPMENT

Alessandro Bonito-Oliva

ANSALDO GIE - NHMFL

ANSALDO experience on CICC technology (main projects):

completed:

- development and manufacturing of the electric terminations and joints for 40KA NET-ITER conductor prototype.

- development and construction of a 12 T, 0.6 m bore, Nb_3Sn, CICC "wind and react" solenoid.

in progress:

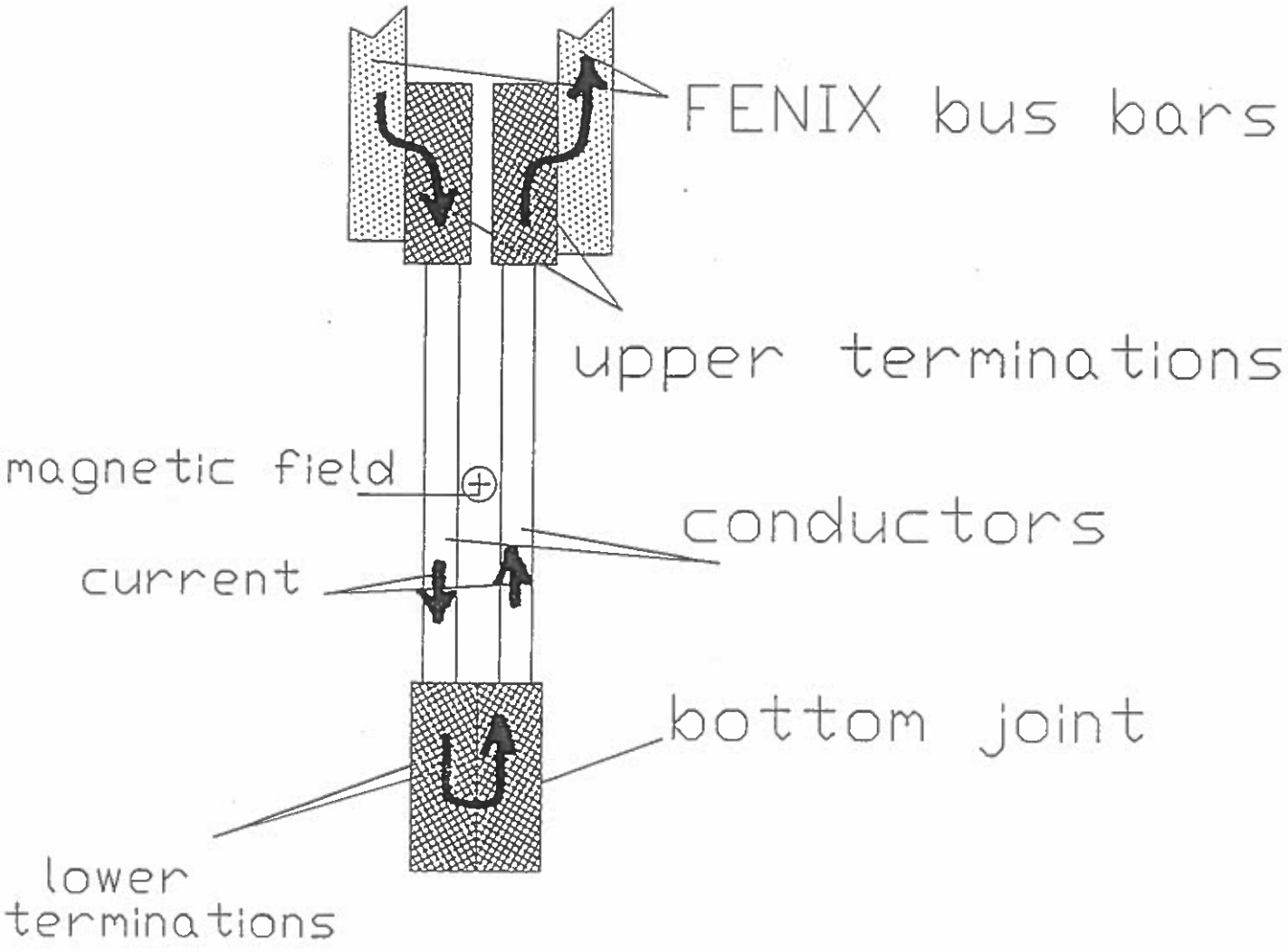
- development and manufacturing of a 2 m long, 0.7*0.5 m^2 bore NbTi CICC dipole for MHD.

- jacketing of 340 m of full size ITER conductor.

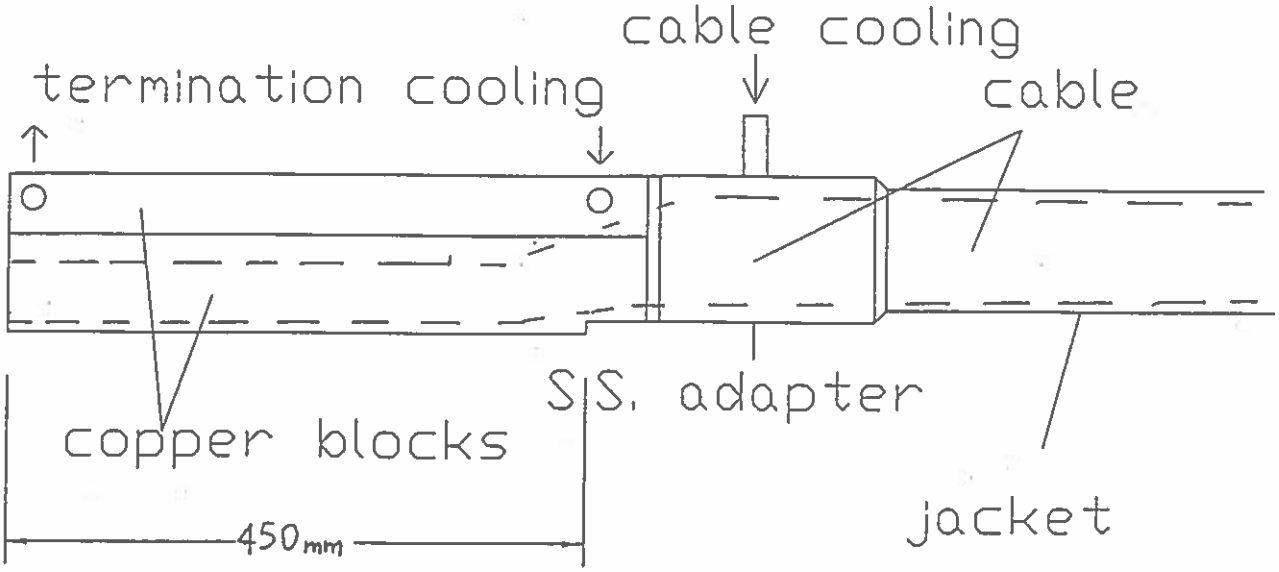
- feasibility study on ITER coils system.

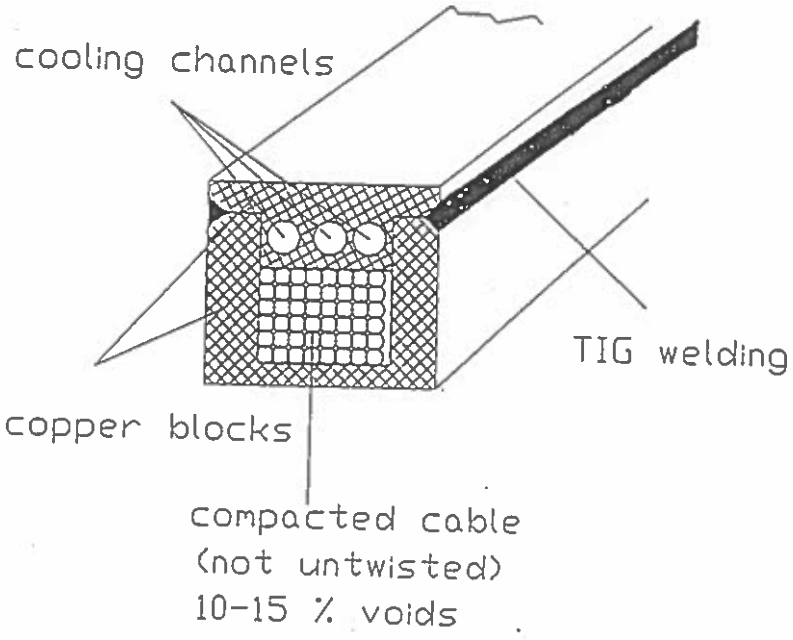
DESIGN AND CONSTRUCTION OF THE ELECTRIC TERMINATIONS AND JOINTS FOR THE SAMPLE OF THE 40 KA LMI VERSION OF NET-ITER CONDUCTOR TESTED IN FENIX.

FENIX sample



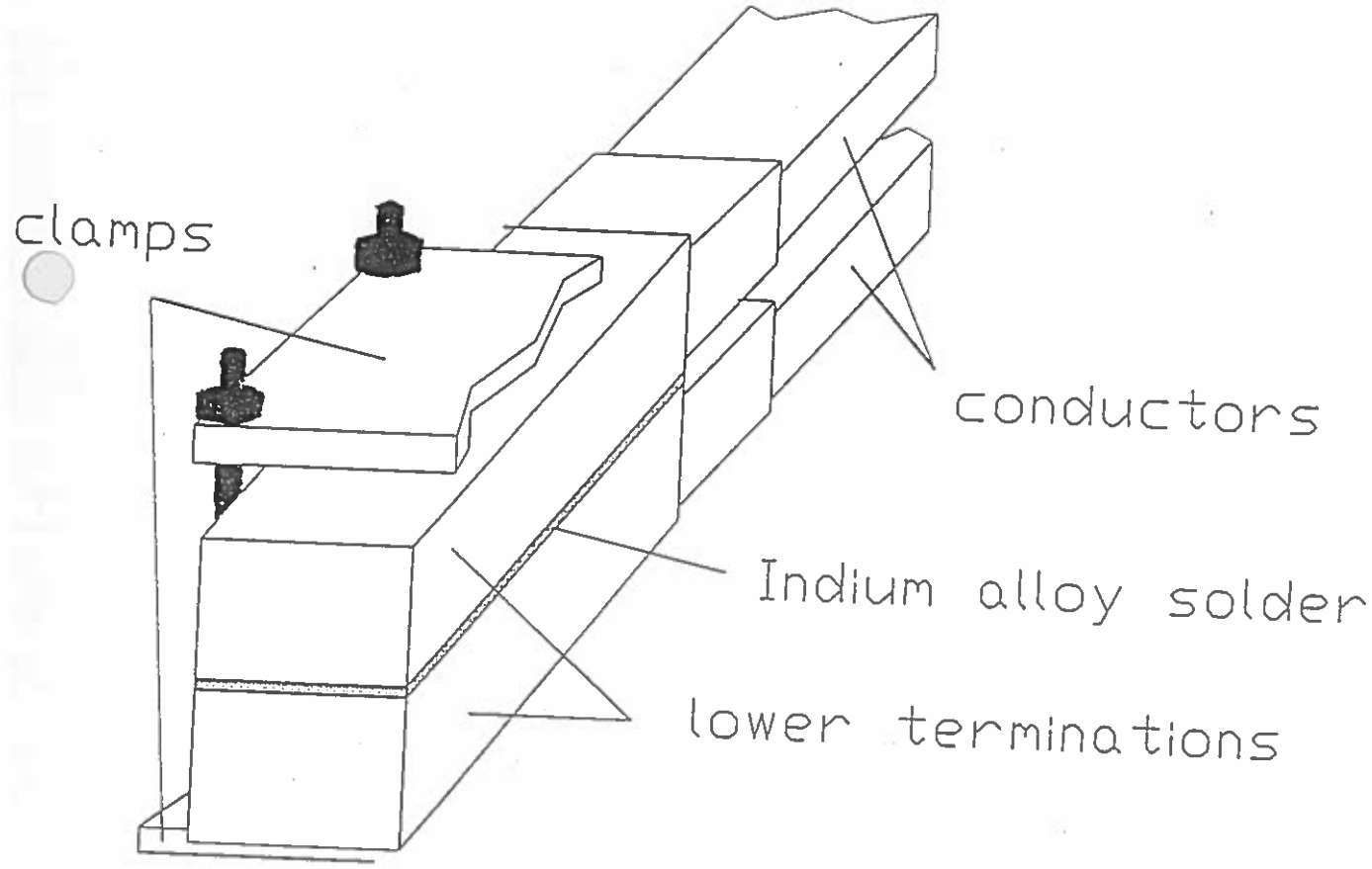
ANSALDO DESIGN FOR THE NET-ITER CONDUCTOR TERMINATIONS:





A section of the termination

FENIX SAMPLE BOTTOM JOINT:



RESULTS OF THE TEST IN FENIX :

bottom joint resistance:

$R < .2 \; n\Omega$

upper termination-bus bar joints resistance:

$R < 1 \; n\Omega$

The tests conditions were:

T=4.5 K

I= 40 KA

Bmax = 13.5 T on the conductor

B < 0.7 T on the joint

CONCLUSIONS:

-THE DESIGN GARANTEES A VERY LOW D.C. RESISTANCE

- DUE TO THE VERY LOW TRANSVERSAL RESISTANCE OF THE TERMINATION THIS DESIGN IS NOT SUITABLE FOR A.C. OPERATION

(During the tests the current redistribution time in the terminations, after the sample ramping, was very long (≈ 30 sec.))

DEVELOPMENT AND CONSTRUCTION OF the ENEA-EURATOM 12 T 0.6 m BORE, CICC, "wind and react" SOLENOID

MAIN CHARACTERISTICS OF THE 12 T CICC MAGNET

winding type	solenoid, layer wound
cooling	forced flow, supercritical helium, Tin=4.5 K, Pin=10bar
design operating current (D.C.)	6000 A
max.field on the conductor*	12 T
max.field on the joints*	10 T
max.field on the exits*	8 T

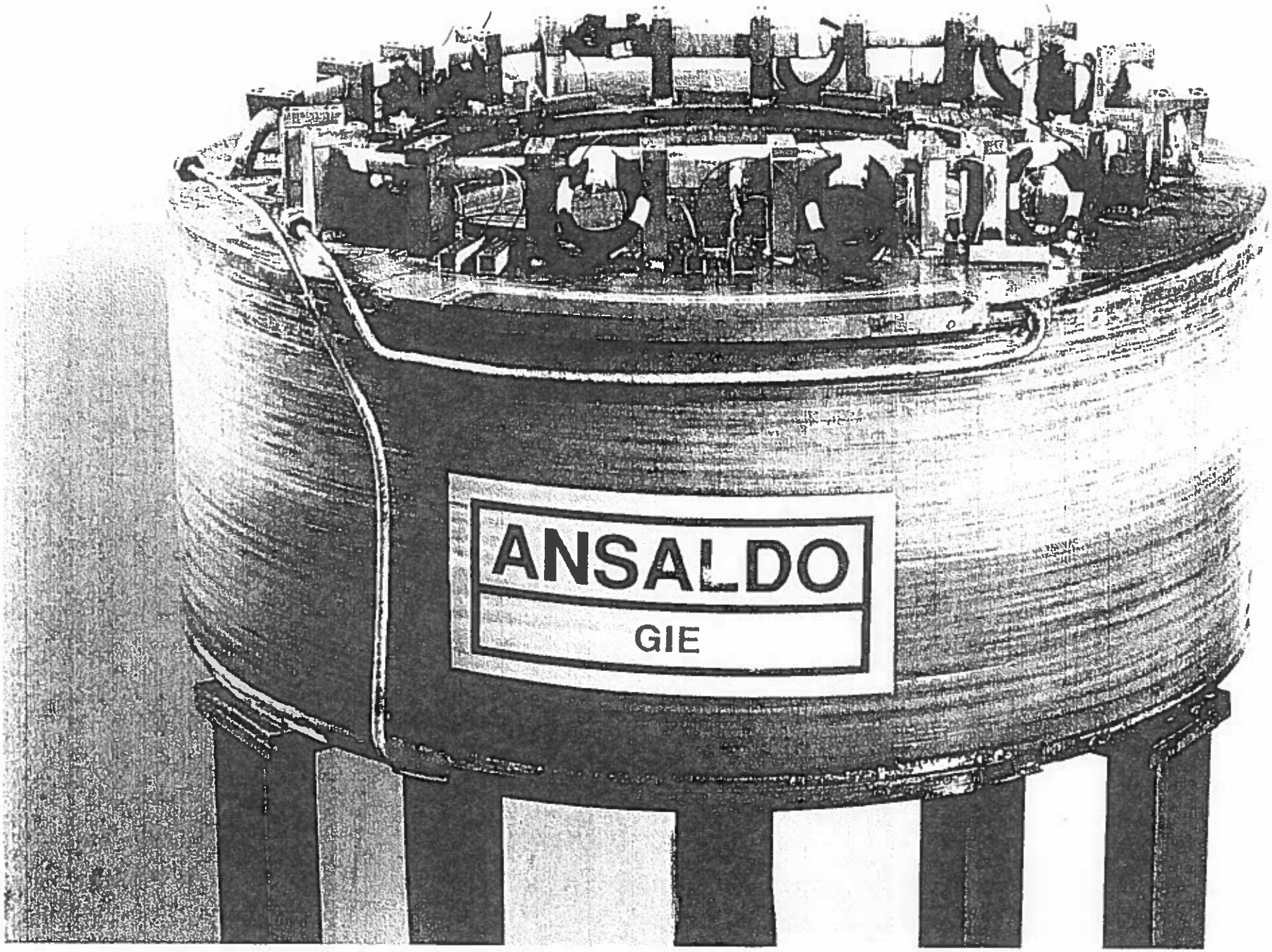
COIL

inner diameter	604 mm
outer diameter	1022 mm
axial length	388 mm
number of layers	13
number of turns	286
number of interlayer joints	2

CONDUCTOR (CICC)

overall dimension	13.8 * 13.8 mm2
jacket thickness (AISI 316 LN modified)	1.4 mm
turn insulation thickness	0.75 mm
layer insulation thickness	0.4 mm
strands diameter(chrome plated)	0.78 mm
cabling steps	3*3*4*4
total conductor length	745 m (in 3 single pieces)
critical current (at T=4.2 K and B=12 T)	>10000 A

** The field values are referred to the operation of the coil in the SULTAN facility*



THE COIL FINISH...

12 T SOLENOID MANUFACTURING OPTIONS SELECTED:

-WINDING WITHOUT PRE-BENDING

- DESIZING OF THE INSULATION DURING THE HEAT TREATMENT

- REMOVING OF THE COIL FORMER AFTER THE IMPREGNATION USING MICA PAPER AS DEBONDING AGENT.

In order to check the validity of the design some tests have been carried out before to start the coil construction:

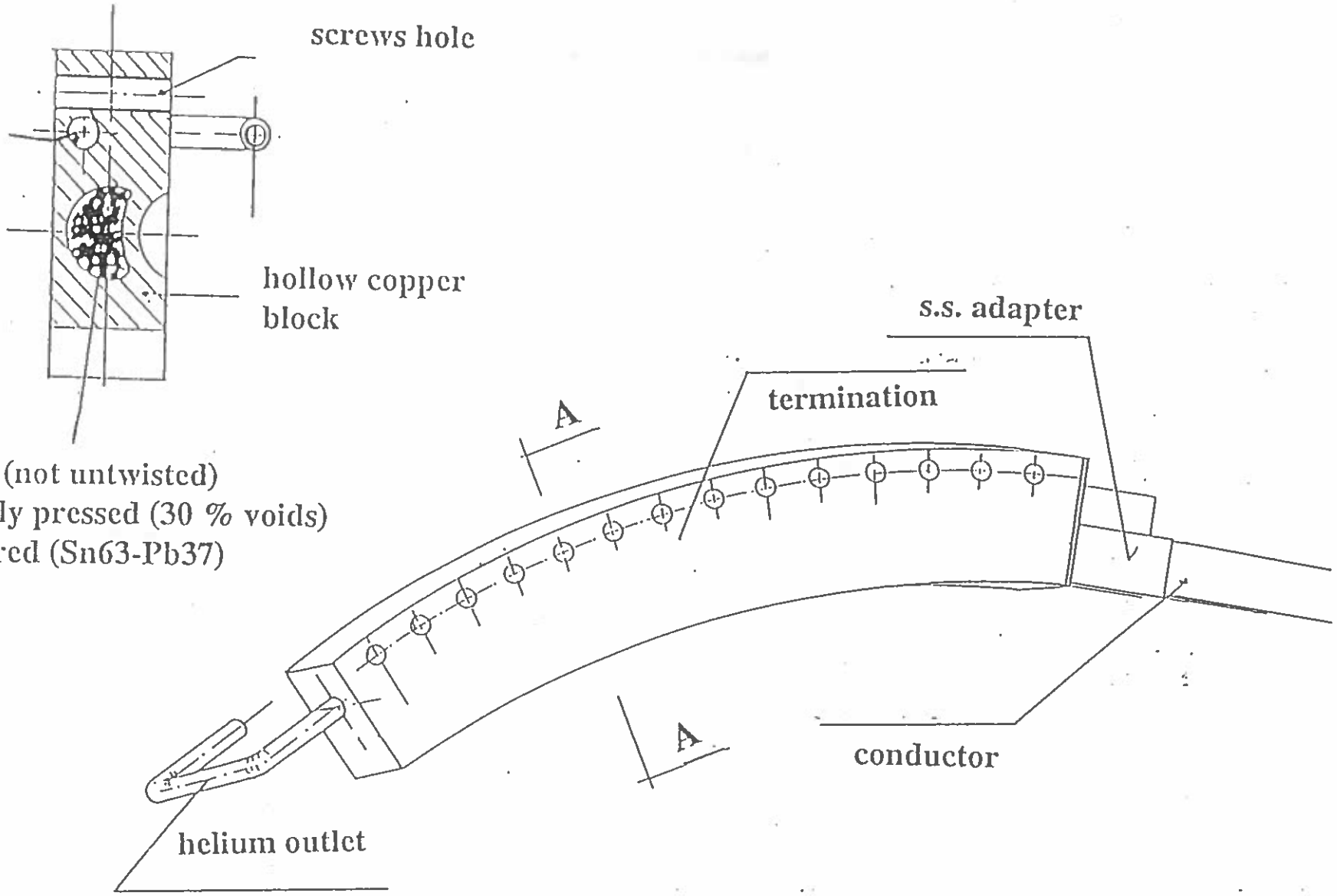
MAIN PRELIMINARY TESTS

- HIGH FIELD TESTS ON COIL TERMINATION AND INTERLAYER JOINT PROTOTYPES

- MANUFACTURING AND LN_2 TESTING OF A MODEL COIL

TEST OF ELECTRIC TERMINATIONS AND INTERLAYER JOINTS PROTOTYPE

sect. A-A (enlarged)



12 T SOLENOID TERMINATION DESIGN