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THE ARES CAVITY

T. Kageyama, Y. Takeuchi, N. Akasaka,
F. Naito, H. Sakai, H. Mizuno, K. Akai,
E. Ezura, H. Nakanishi, and Y. Yamazaki

Accelerator Laboratory, KEK,
Oho 1-1, Tsukuba, Ibaraki, 305, JAPAN

- Introduction (Brief Review of R&D)
- Cavity Production
- SiC Ceramic Absorbers
- Input Coupler
- Summary

- The ARES (Accelerator Resonantly coupled with Energy Storage) structure is a normal conducting coupled cavity system operated in the π/2 mode and designed for use under heavy beam loading environment of KEKB.

- The accelerating cavity is coupled with an energy storage cavity (TE013 mode) via a resonant coupling cavity.

- The coupling cavity is equipped with a coaxial antenna damper in order to reduce the impedances of the parasitic 0 and π modes.

The ARES structure with a coupling cavity operated in the π/2 mode has the following advantages over a non-ARES one, where the accelerating and storage cavities are directly coupled and operated in the π or 0 mode:

- The π/2 mode has excellent field stability against heavy beam loading.

- The stored energy ratio Us:Ua can be easily adjusted by changing the coupling factor ratio ks:ka.

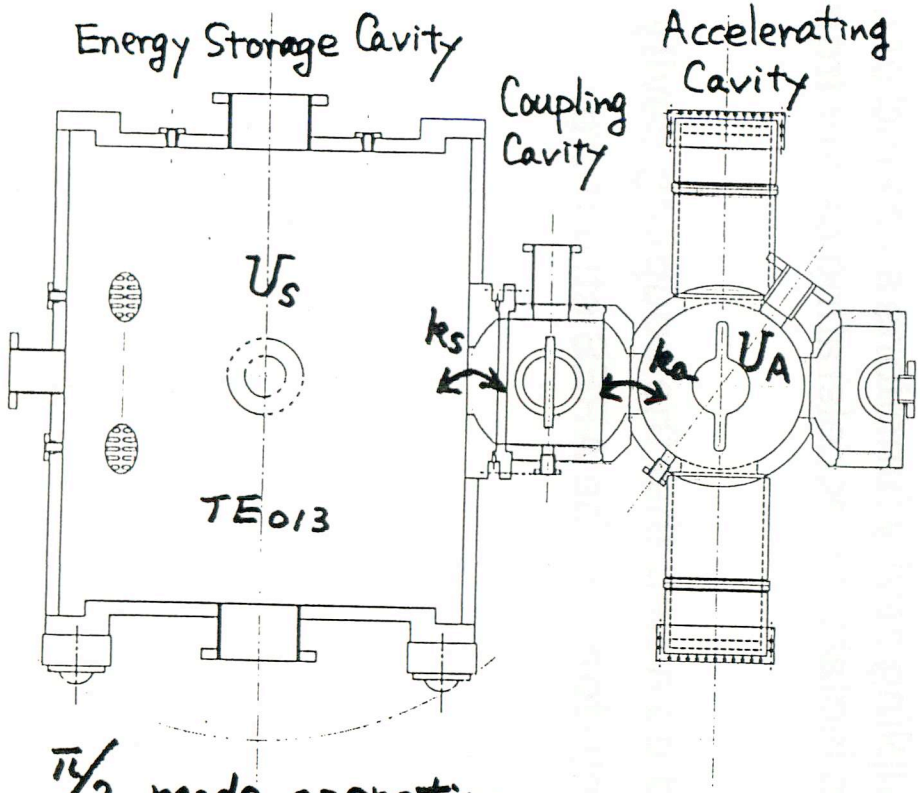
- The parasitic 0 and π modes can be selectively damped by installing a coaxial antenna coupler into the coupling cavity.

- The impedance contributions from the damped 0 and π modes cancel out each other.

- The coupling cavity functions as a kind of filter for some HOM's to isolate the accelerating cavity from the storage cavity.

It should be noted that the coupling cavity functions as the keystone of the ARES structure.

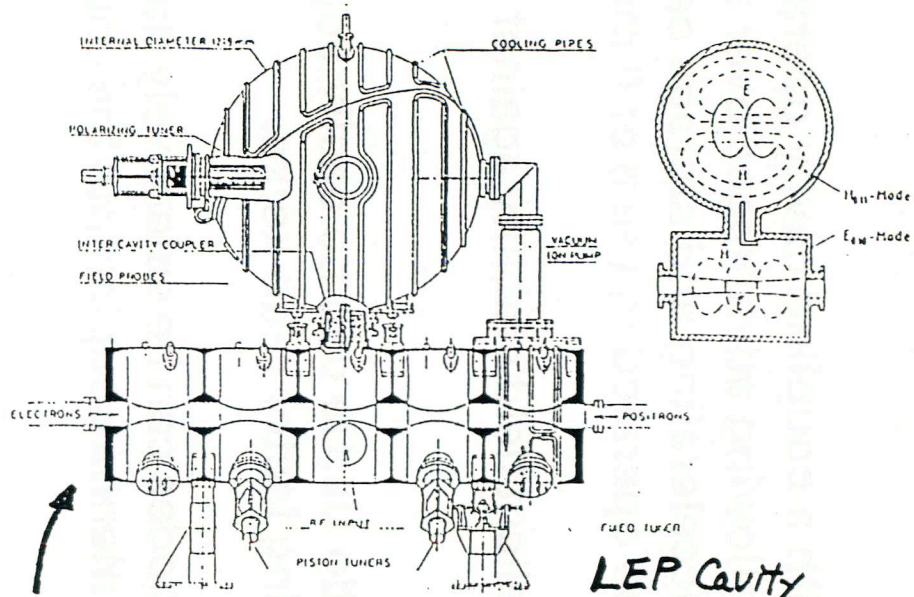
ARES Accelerator Resonantly coupled with Energy Storage



$\pi/2$ mode operation

$$U_S : U_A = k_a^2 : k_s^2$$

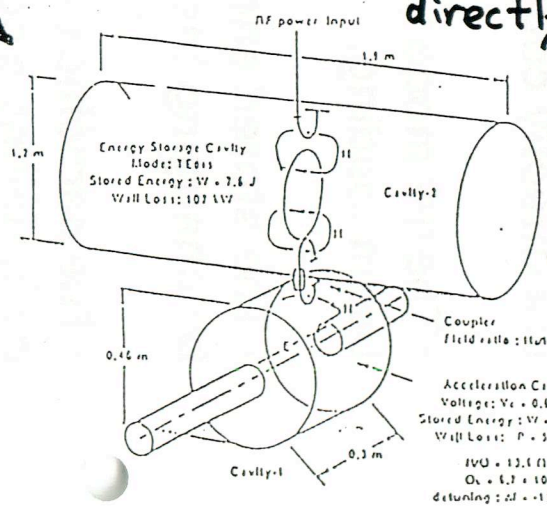
The coupling cavity is the key stone !



LEP Cavity

non ARES structures

Accelerating and storage cavities are directly coupled.



π-mode operation

$U_S : U_A = 1 : 1$

T. Shintake

The ARES structure has been demonstrated through a series of high-power RF tests and high-current beam experiments carried out with two prototype cavities named ARES95 and ARES96.

HOM damping

ARES95
with Quadrupole Counter Mixing (QCM) choke method

ARES96
with Grooved Beam Pipe (GBP) method

The production cavity design is based on ARES96.

High-power tests

- ARES95 (Vc = 0.5 MV with Pc = 150 kW)

  maximum continuous
  P_c < 170 kW

- ARES96 (Vc = 0.5 MV with Pc = 150 kW)

  maximum continuous
  P_c < 380 kW

  maximum (20 minutes)
  P_c < 450 kW

Beam experiments

for both prototypes in TRISTAN AR
Oct. 17~Dec. 2, 1996

V_c = 0.4~0.5 MV, P_b ≤ 80 kW

Single bunch	≤ 100 mA
Four bunches	≤ 200 mA
Four four-bunch trains	≤ 500 mA

HOM loads

- Bullet-shape sintered SiC ceramic absorbers

Two absorbers (ϕ 55mm x 400mm) per HOM waveguide

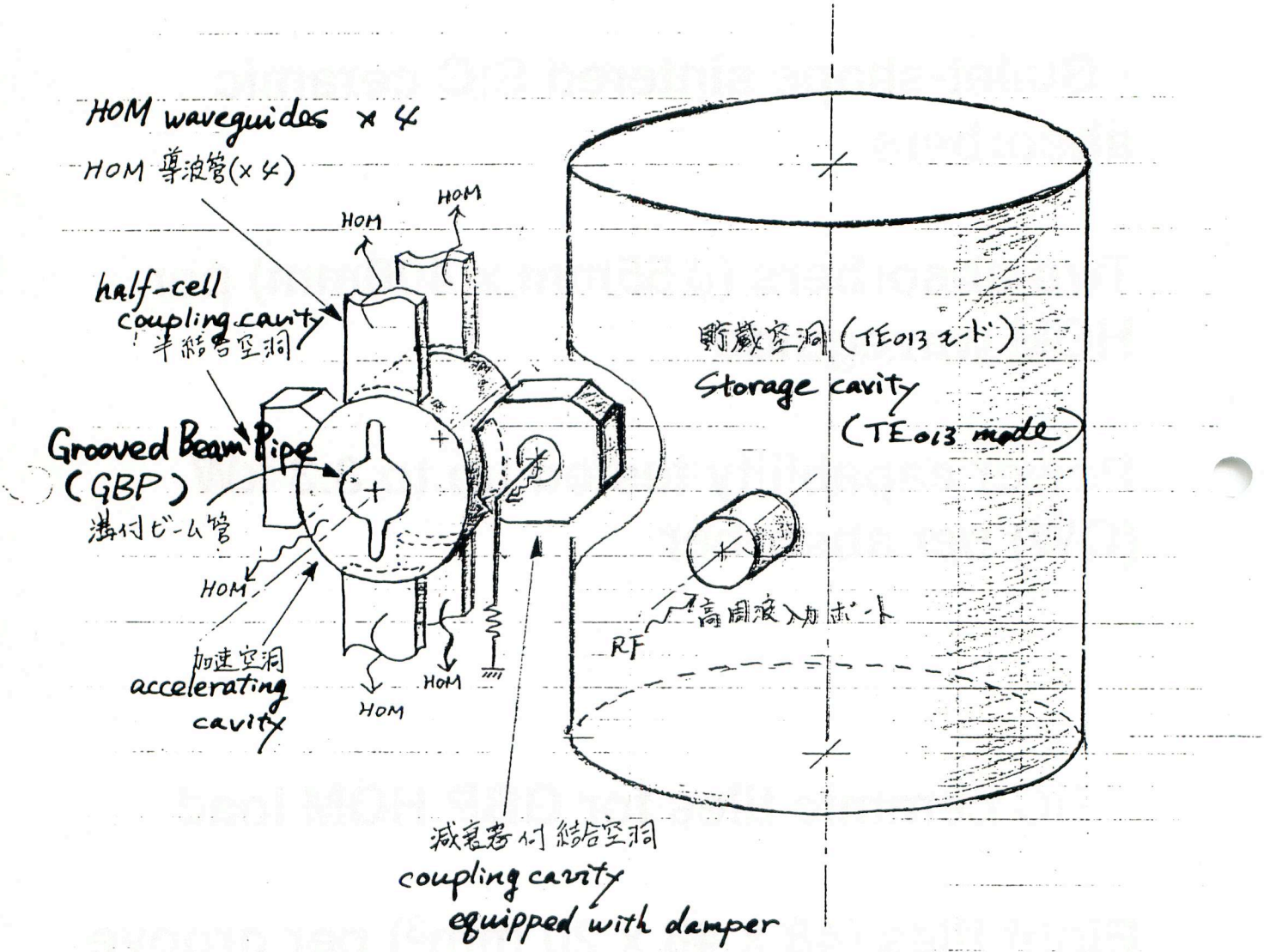
Power capability tested up to 3.3 kW (CW) per absorber

- SiC ceramic tiles for GBP HOM load

Eight tiles (48 x 48 x 20 mm^3) per groove

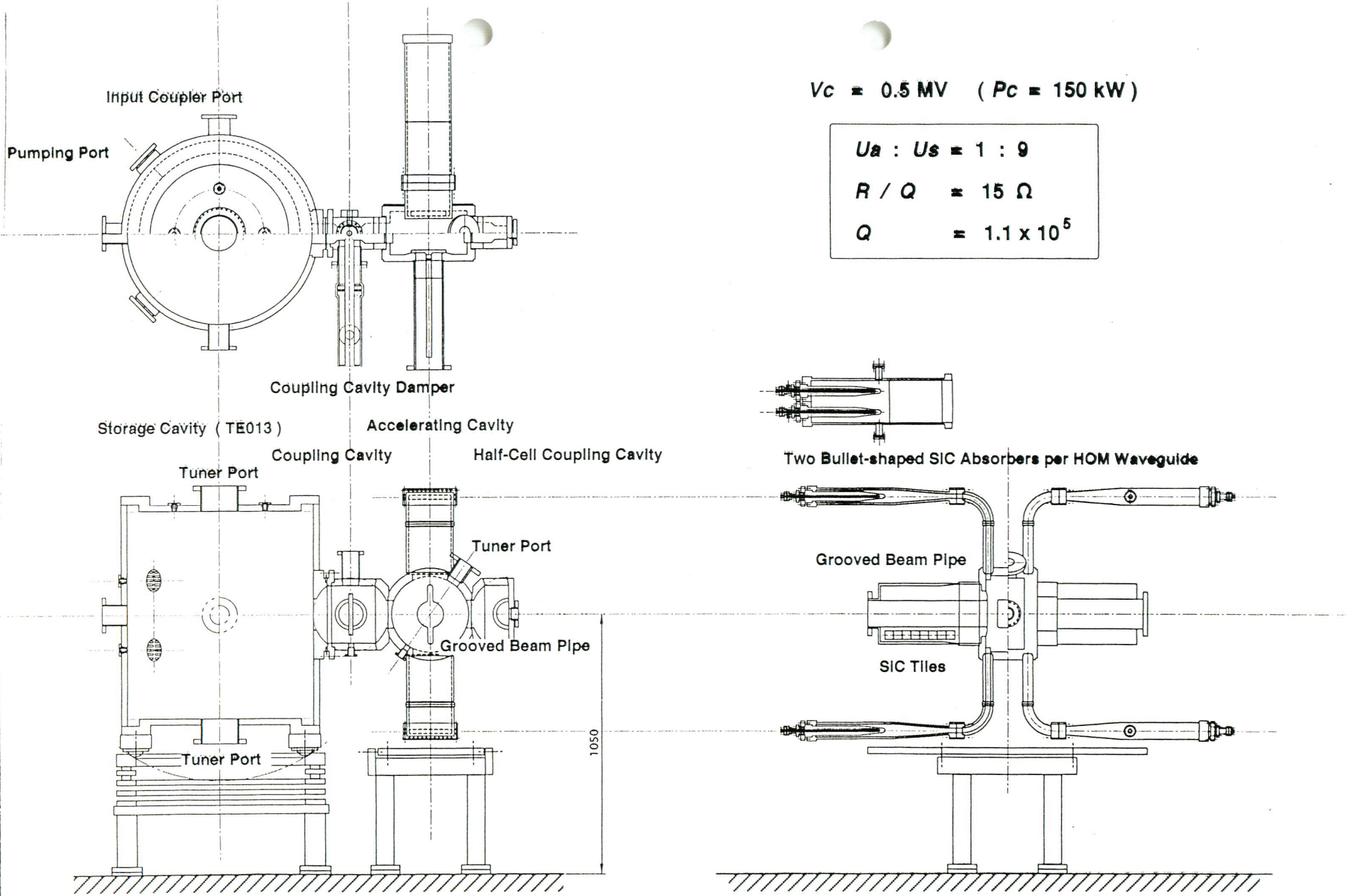
Power capability tested up to 0.25 kW (CW) per groove.

Power capability upgraded up to 0.5 kW by brazing tiles to a copper plate cooled by water.



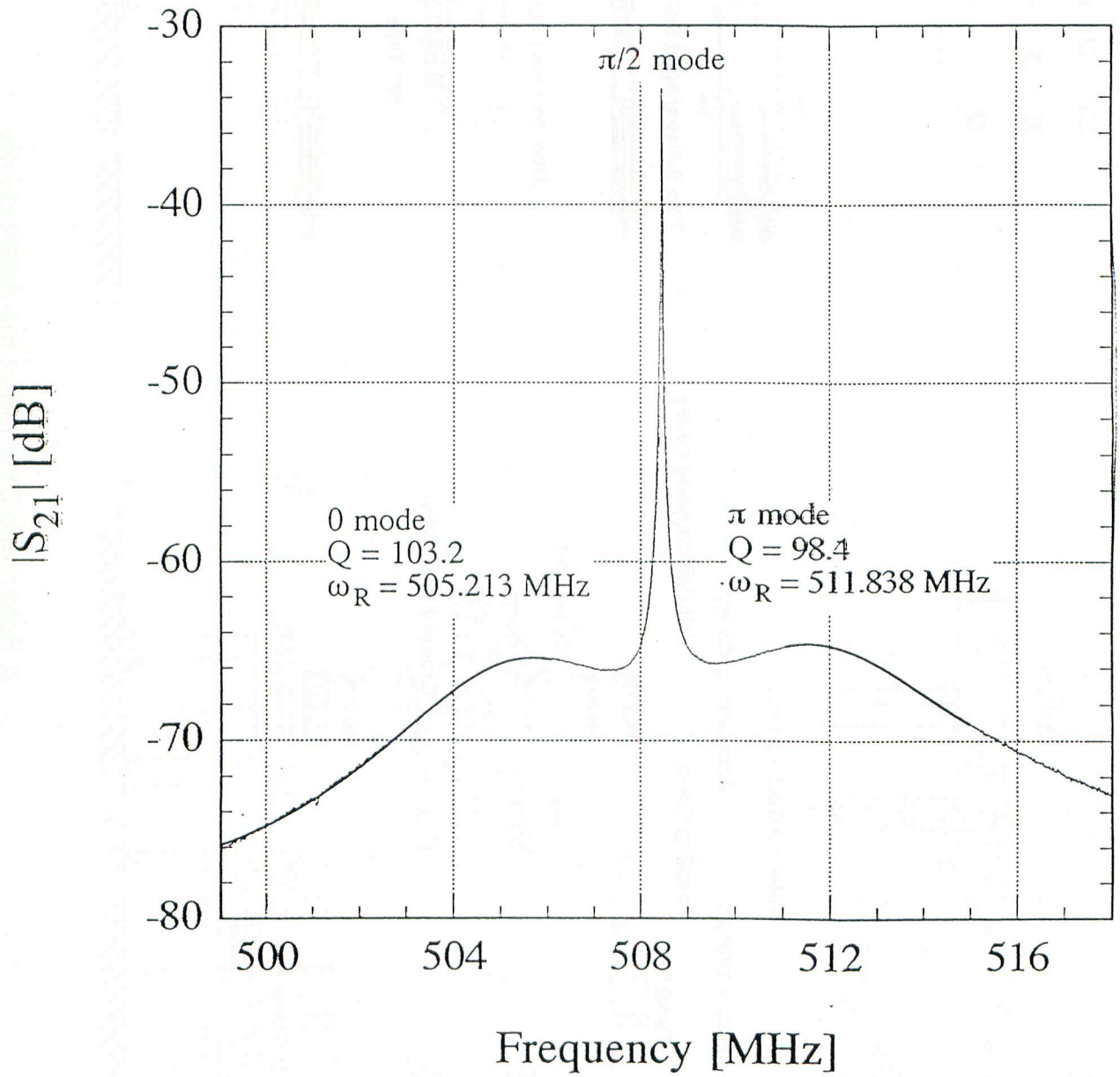
ARES 96

96試 ARES 空洞

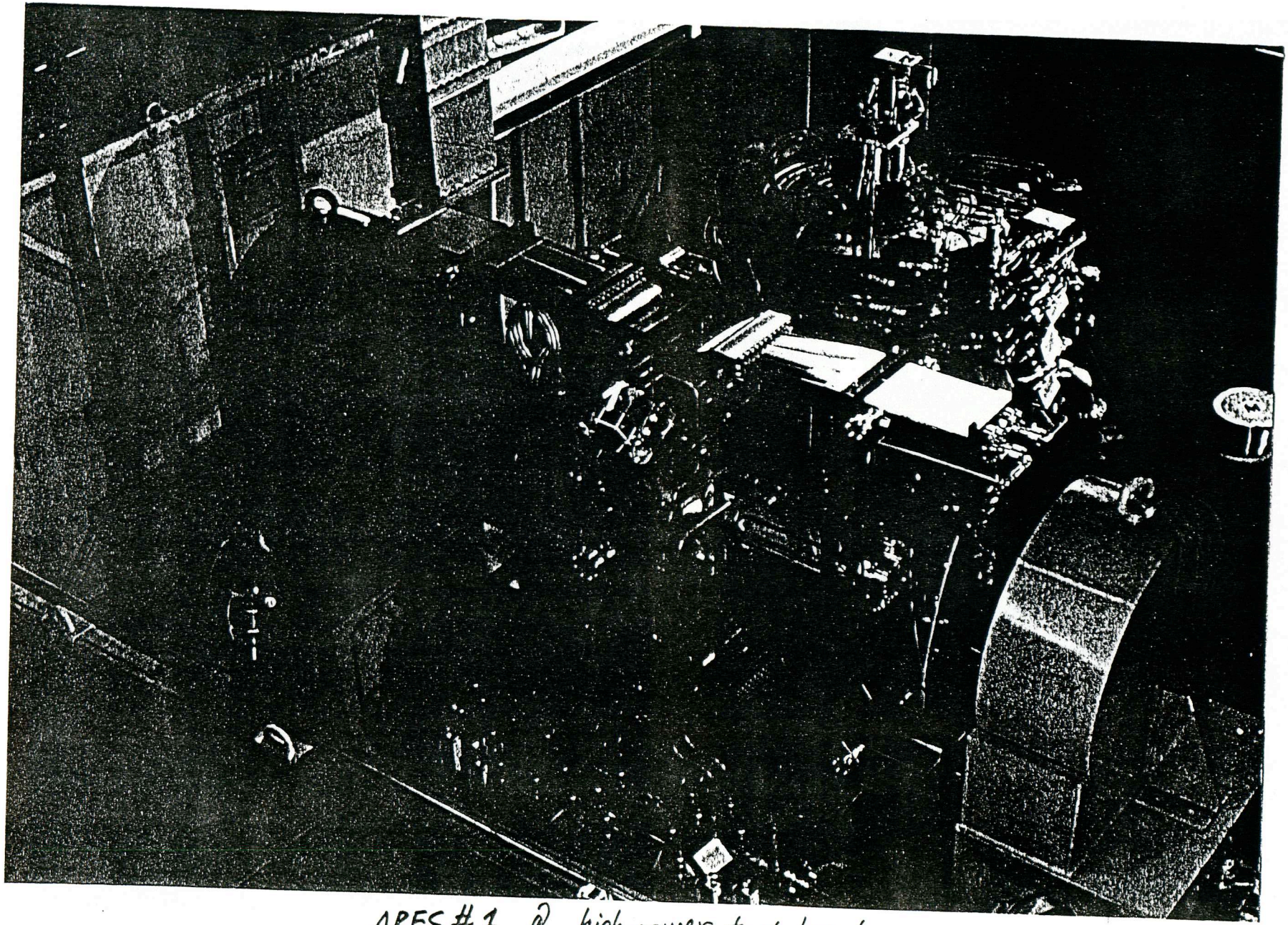


A Schematic Drawing of the ARES Cavity

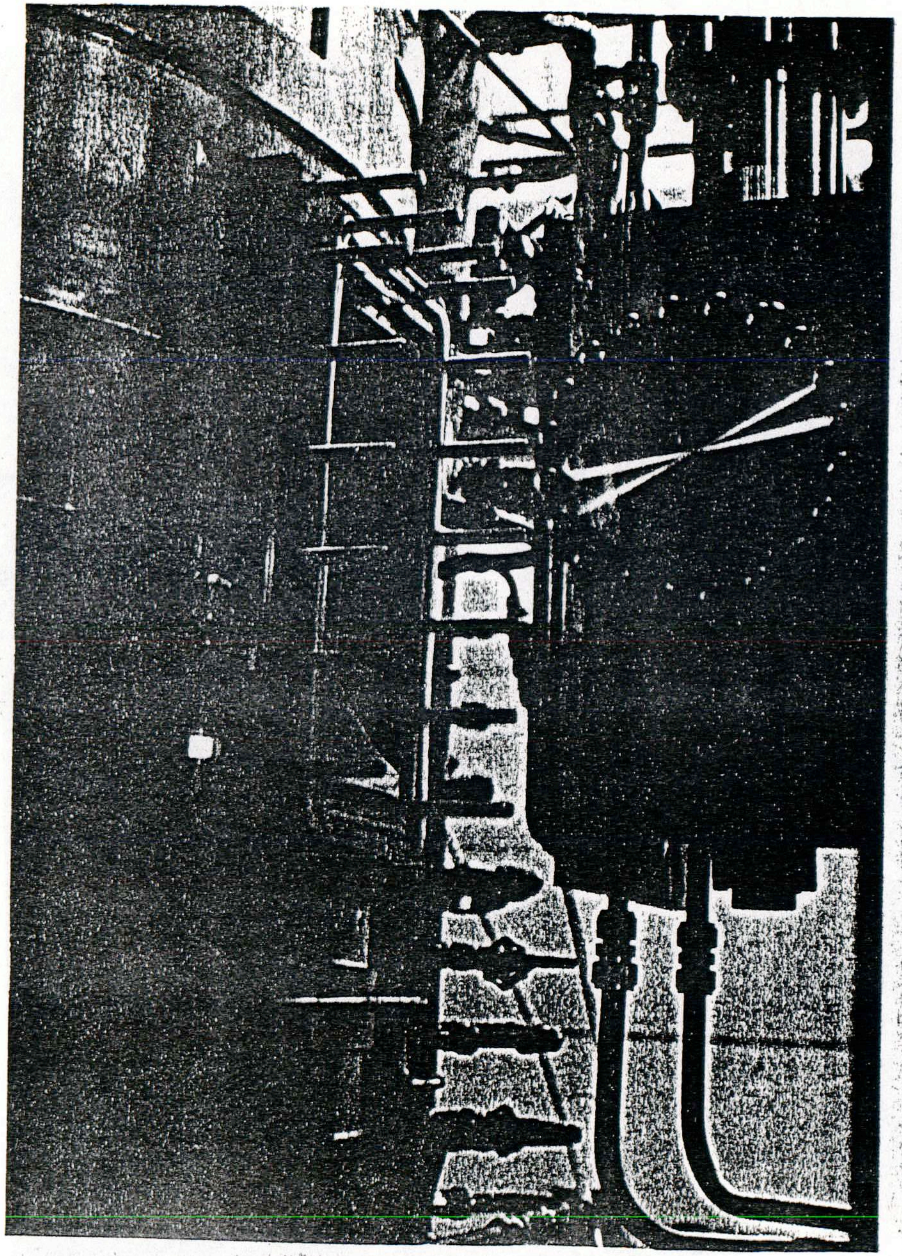
ARES96#1 0, π モード
測定 10月 '96

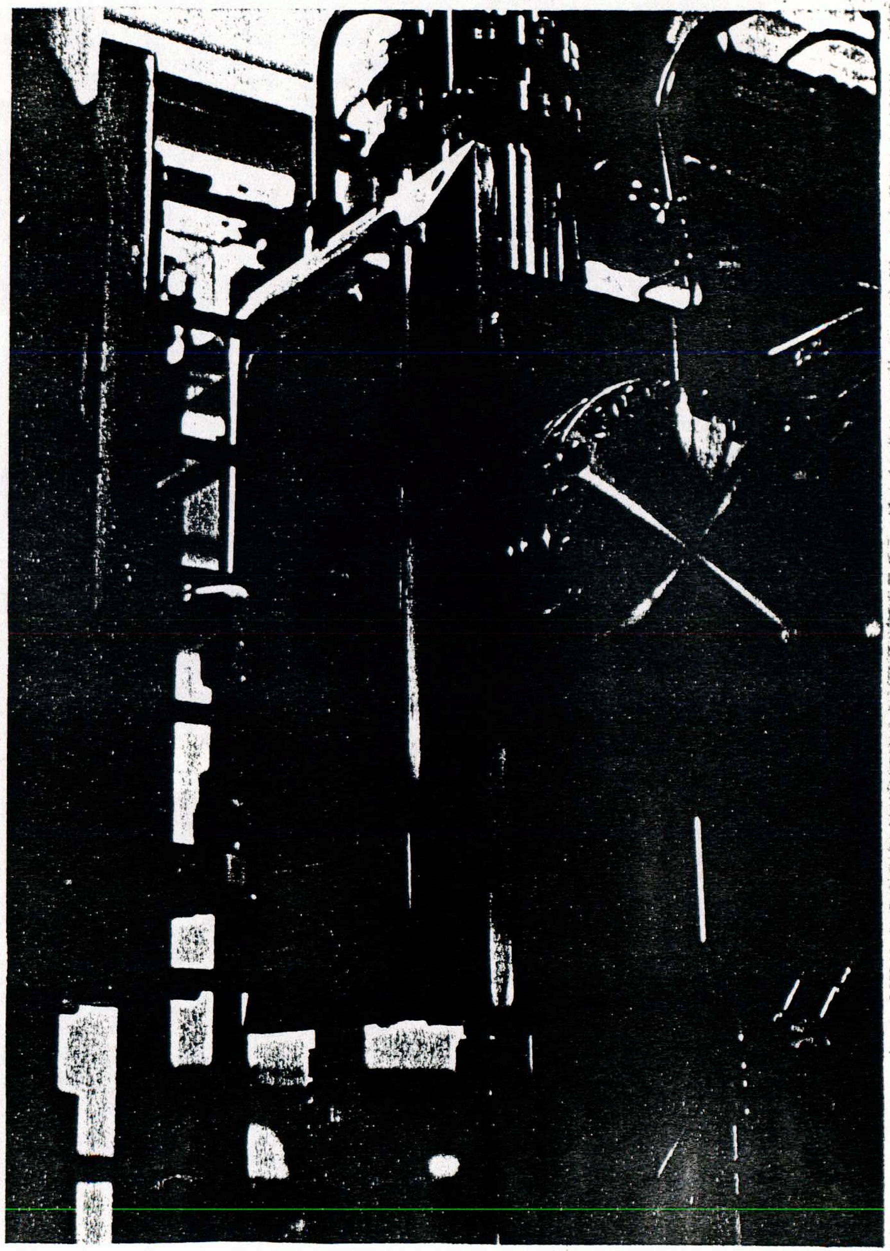


ARES 96

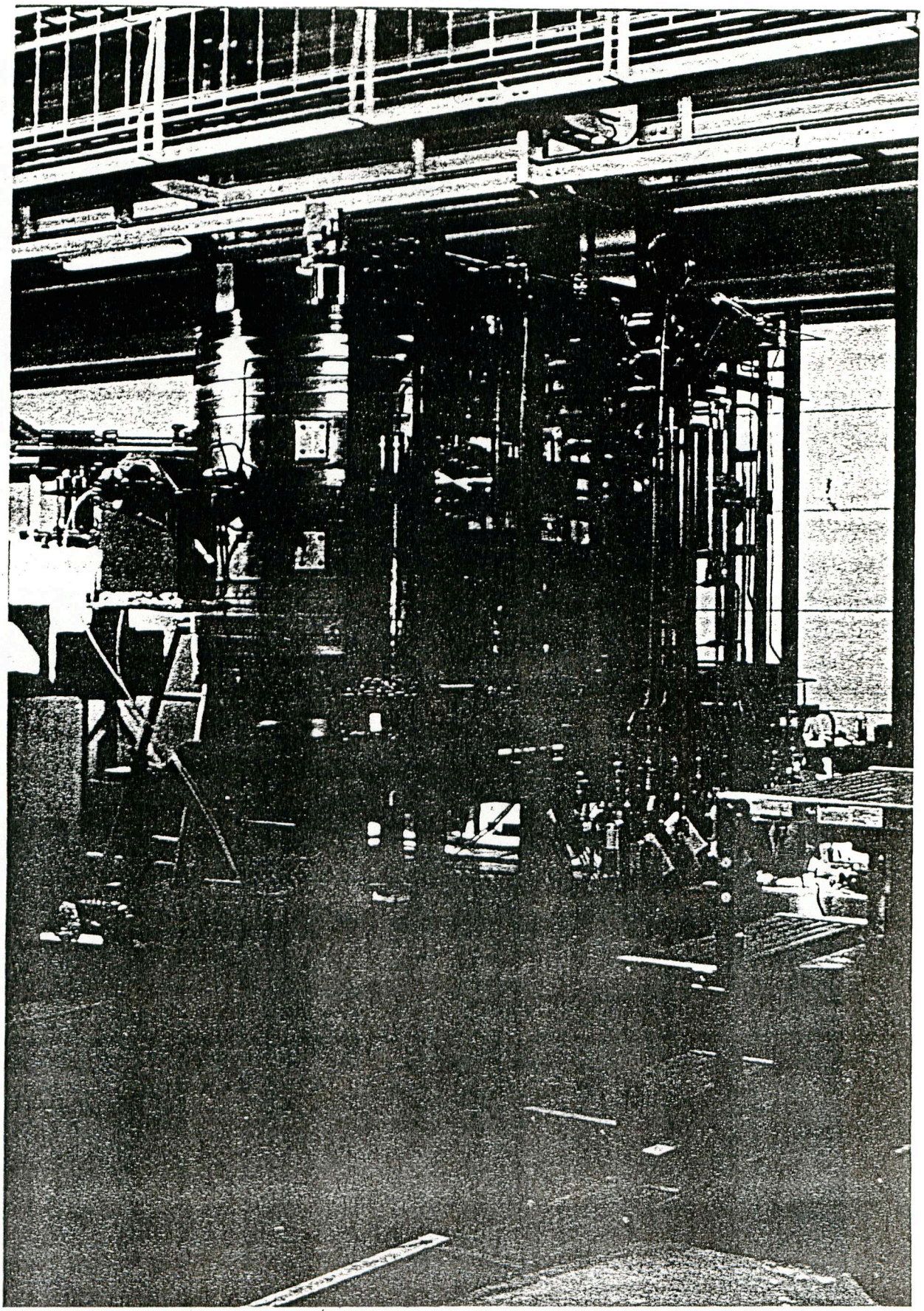


ARES #1 @ high-power test bench

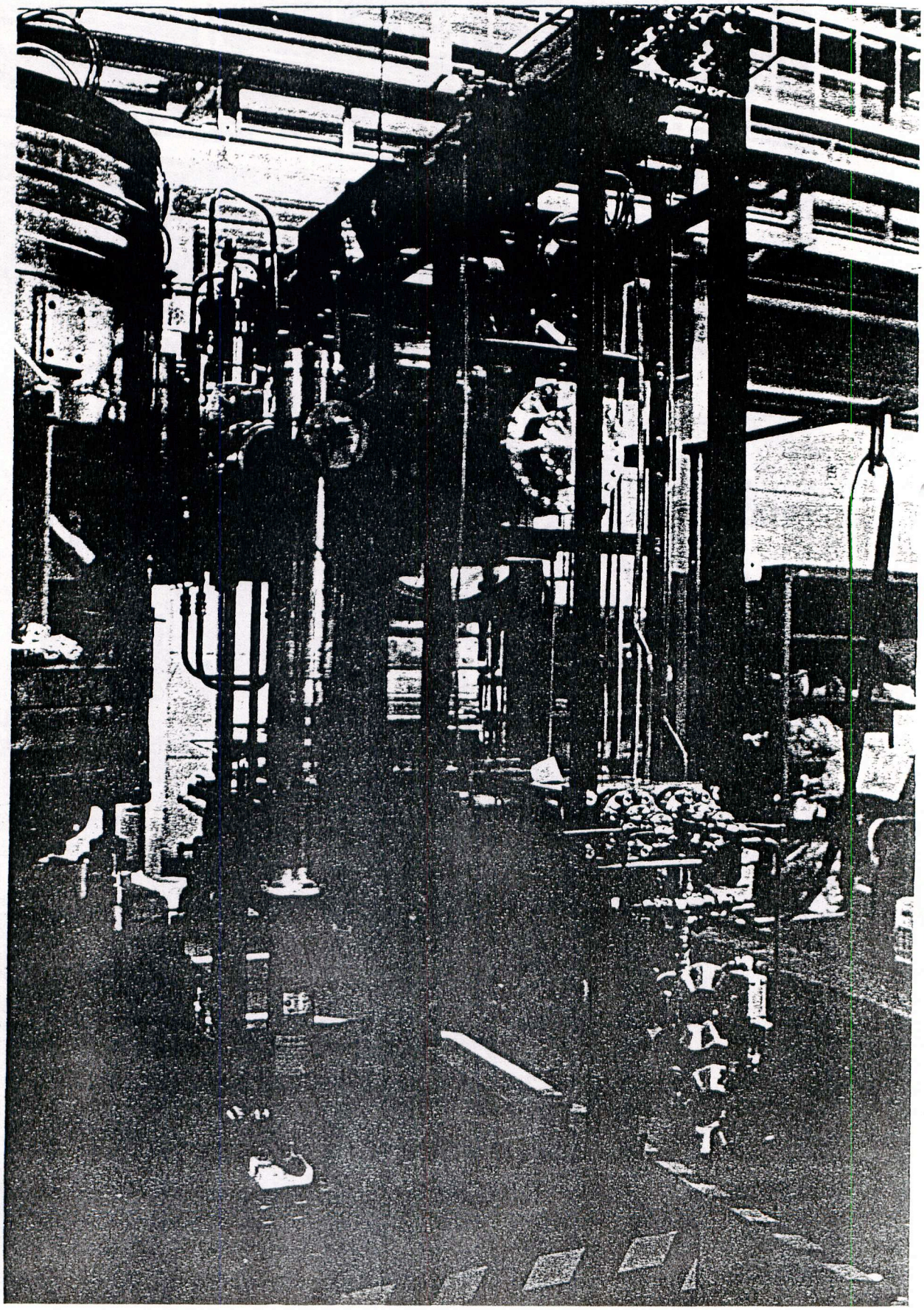




← Storage Cavity → Coupling Cavity

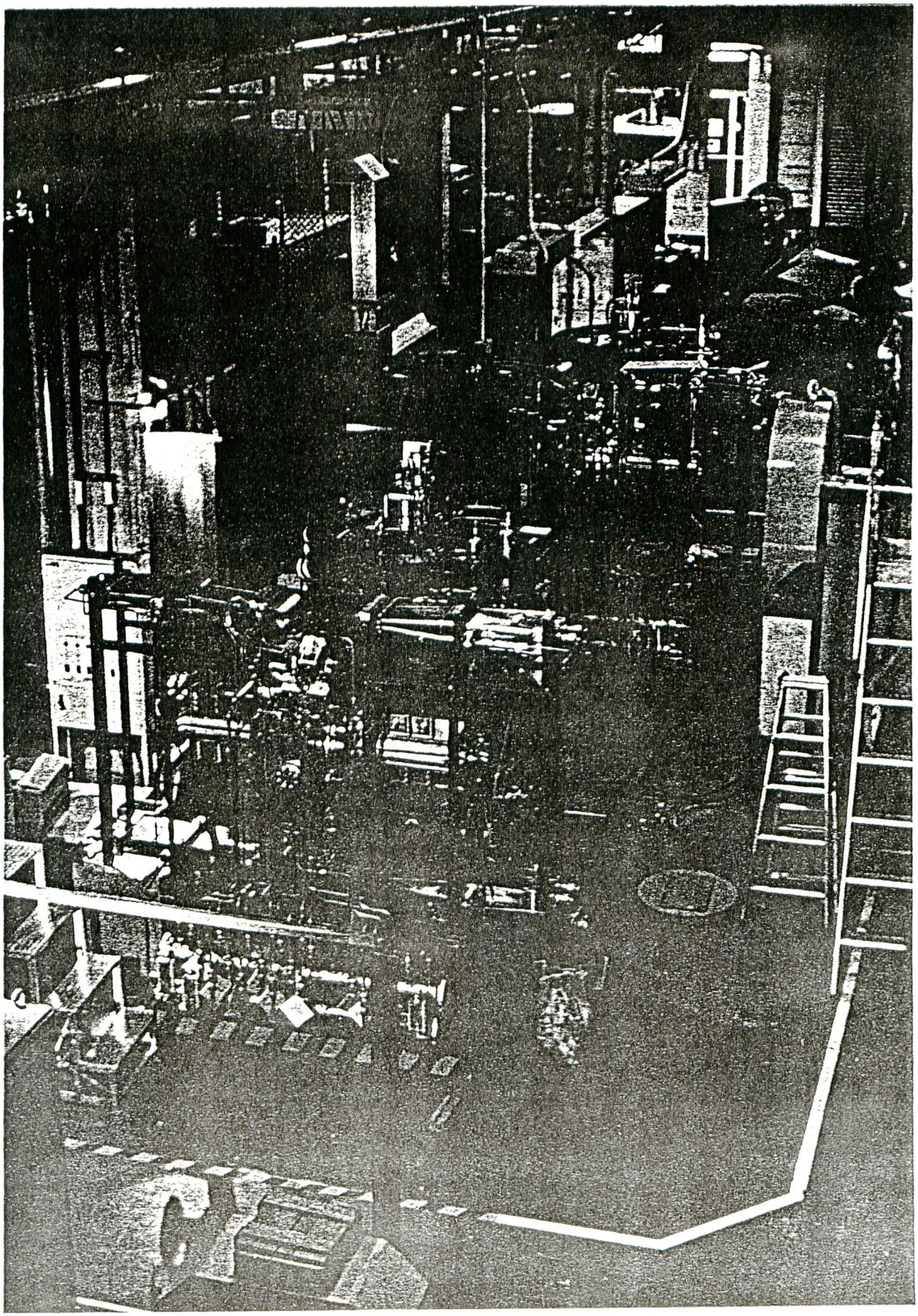


ARES #1

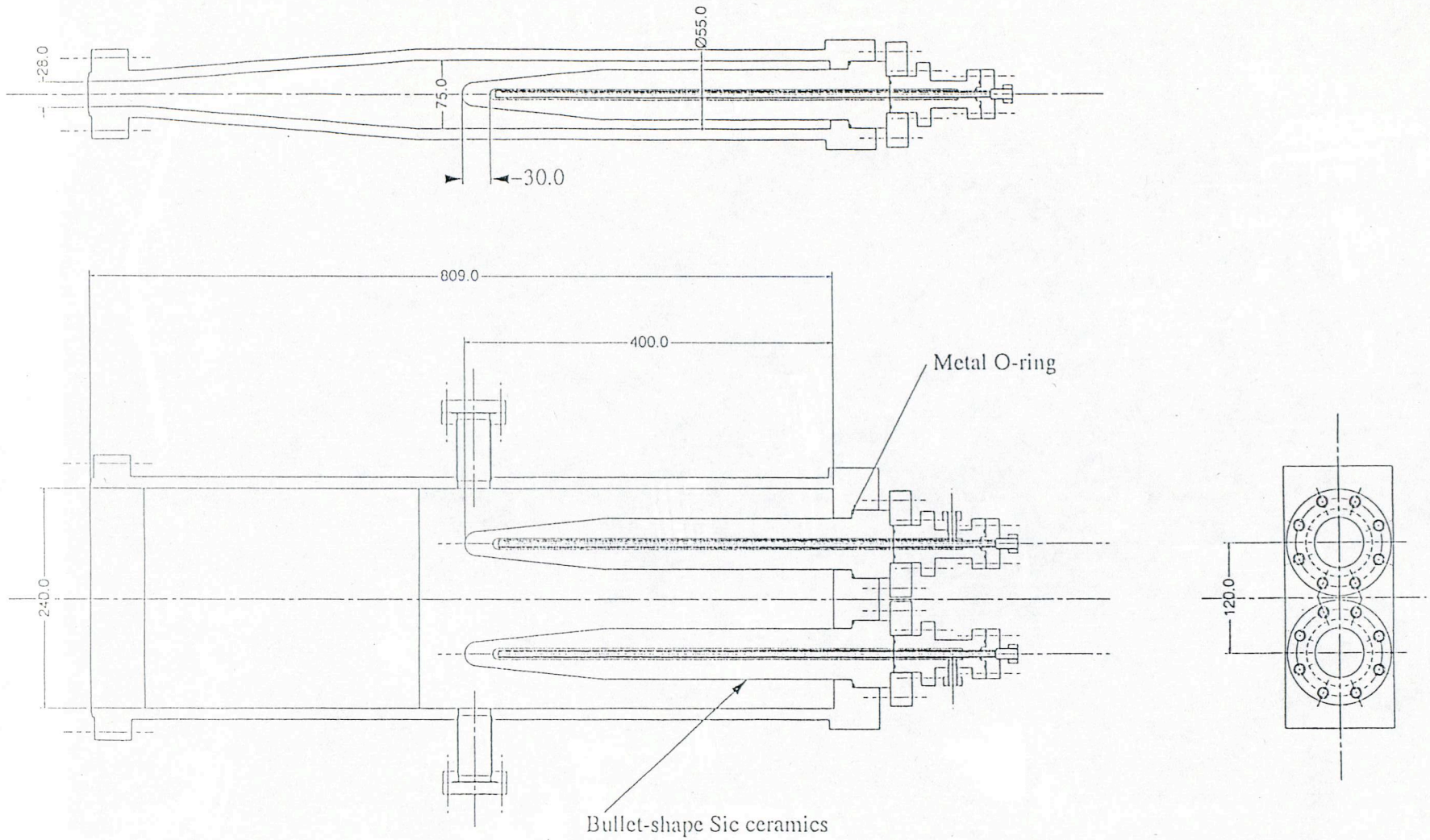


↑
Coupling Cavity Damper

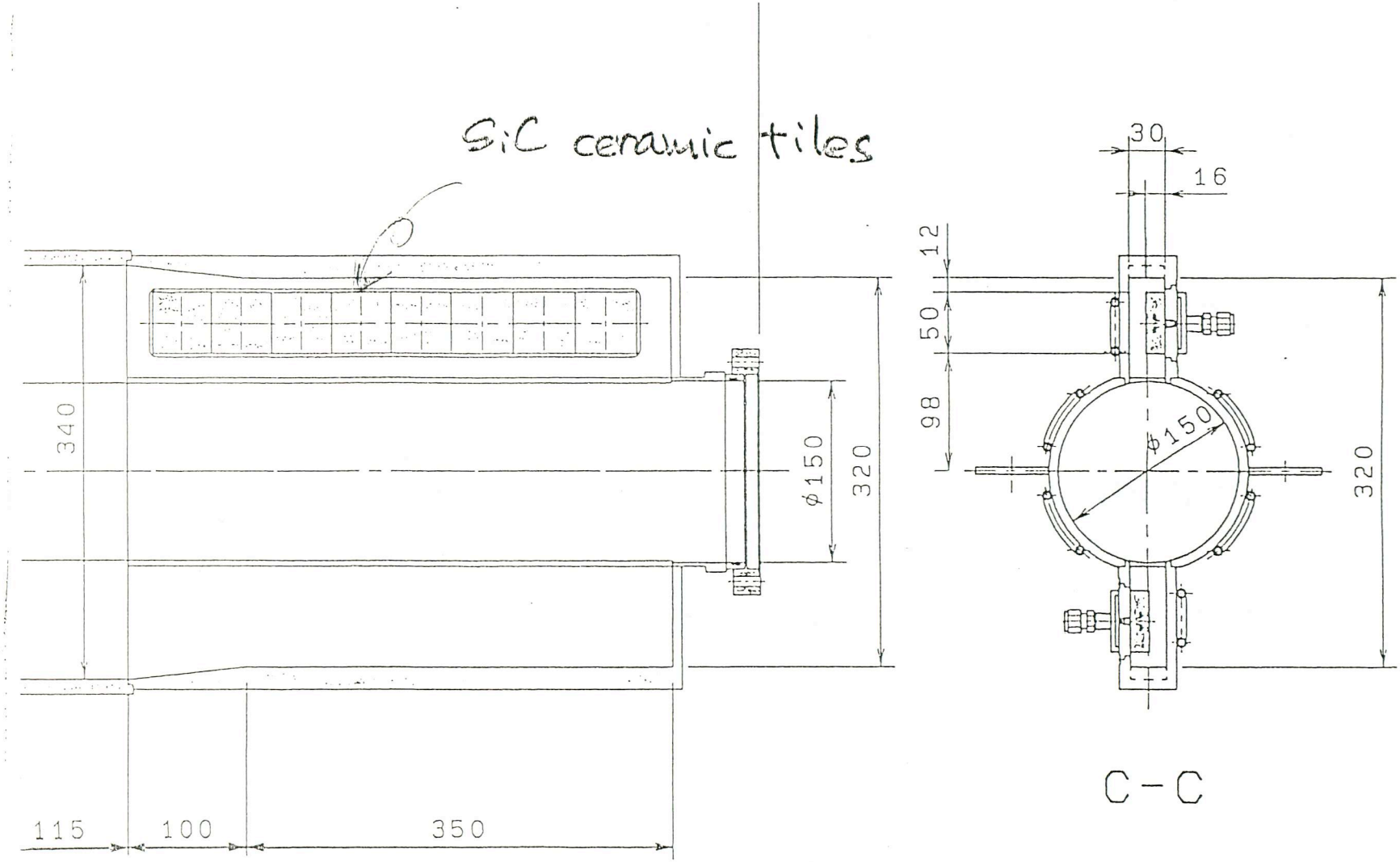
(ARES #1)



ARES#1 ARES #2



Waveguide HOM load for the ARES96


SiC ceramic tiles
340
φ150
320
115
100
350
30
16
12
50
98
φ150
320
C – C

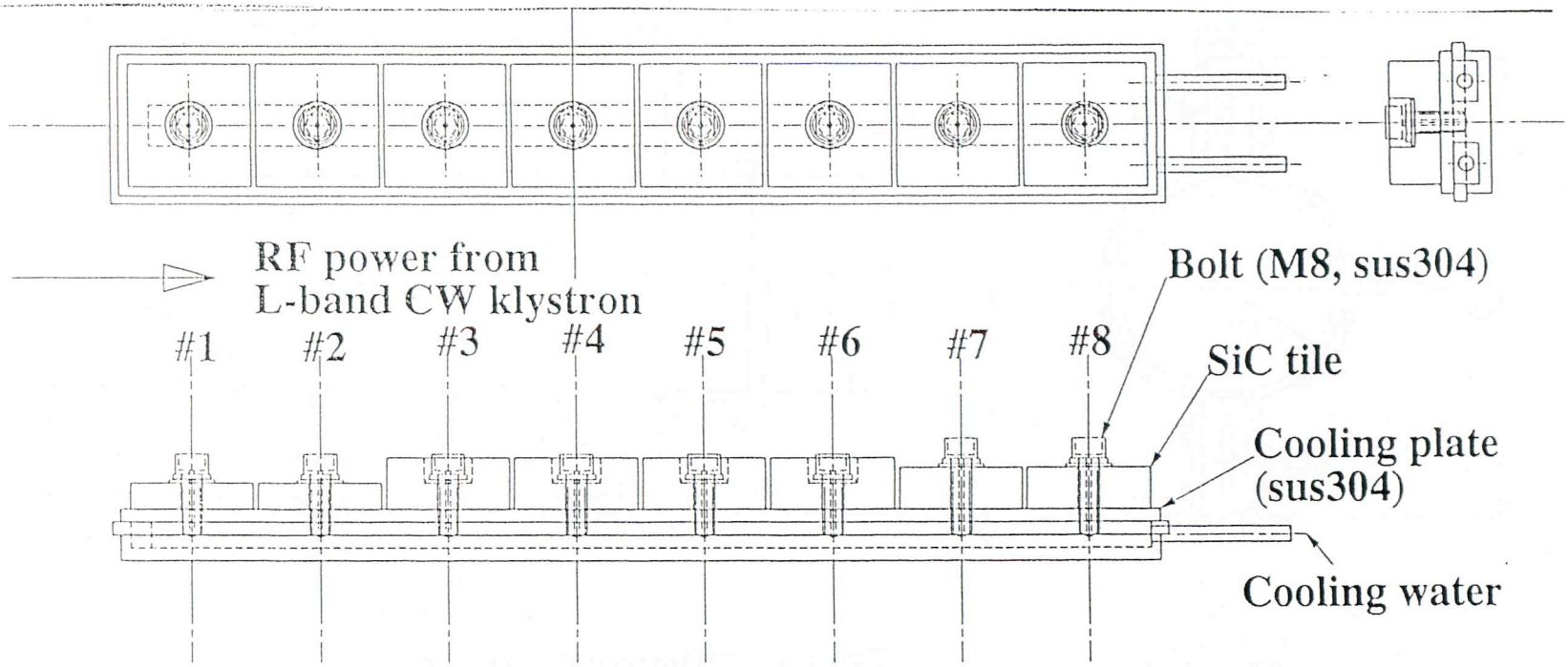
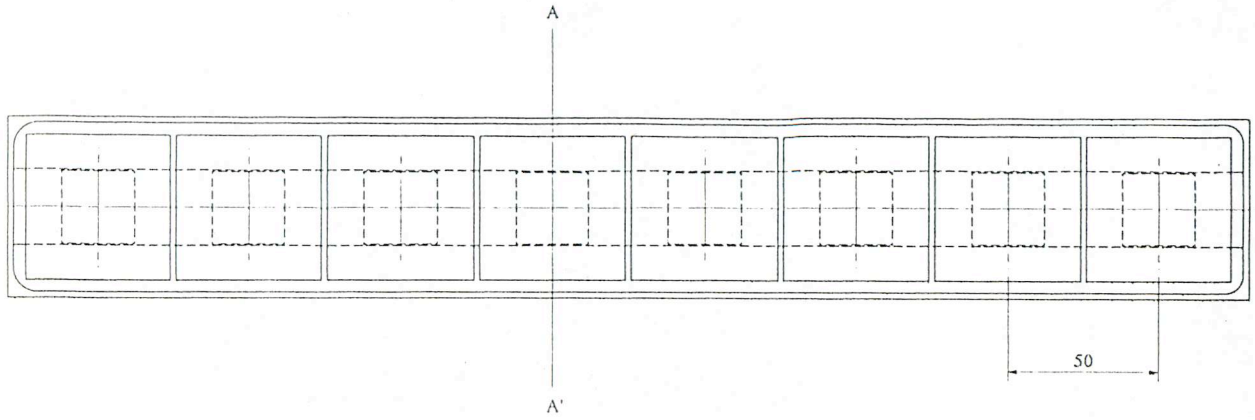
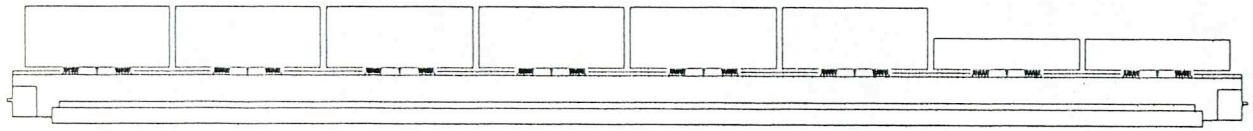


Figure 8: The schematic drawing of the test sample.

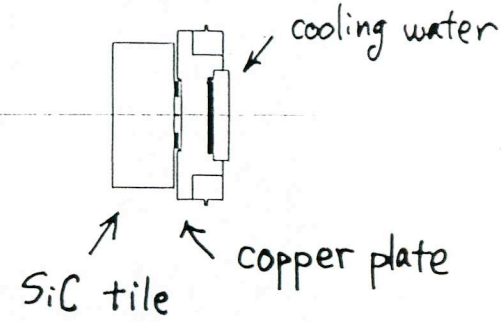
for the prototype ARES 96





断面　Y-Y'

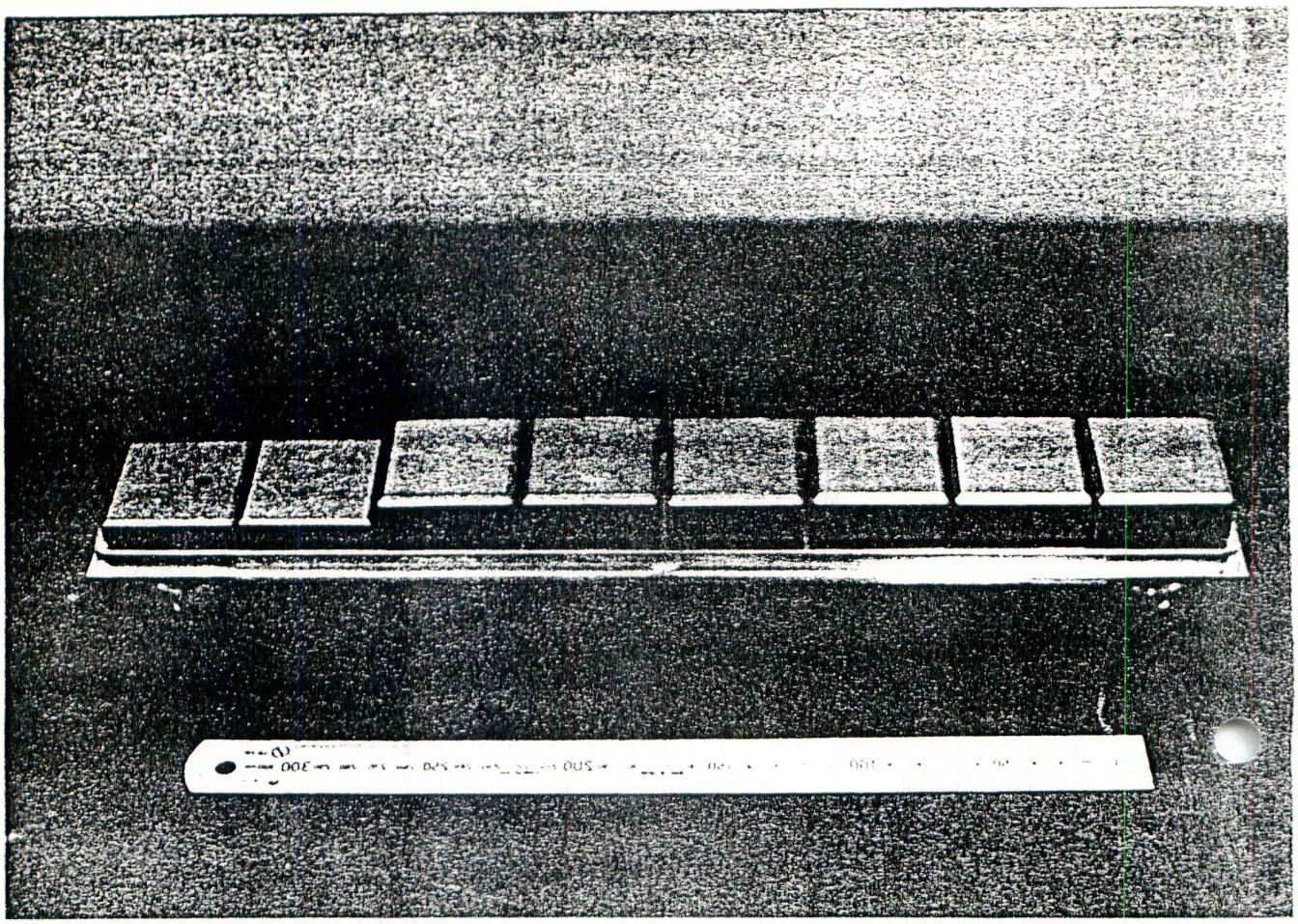
断面図　A-A'

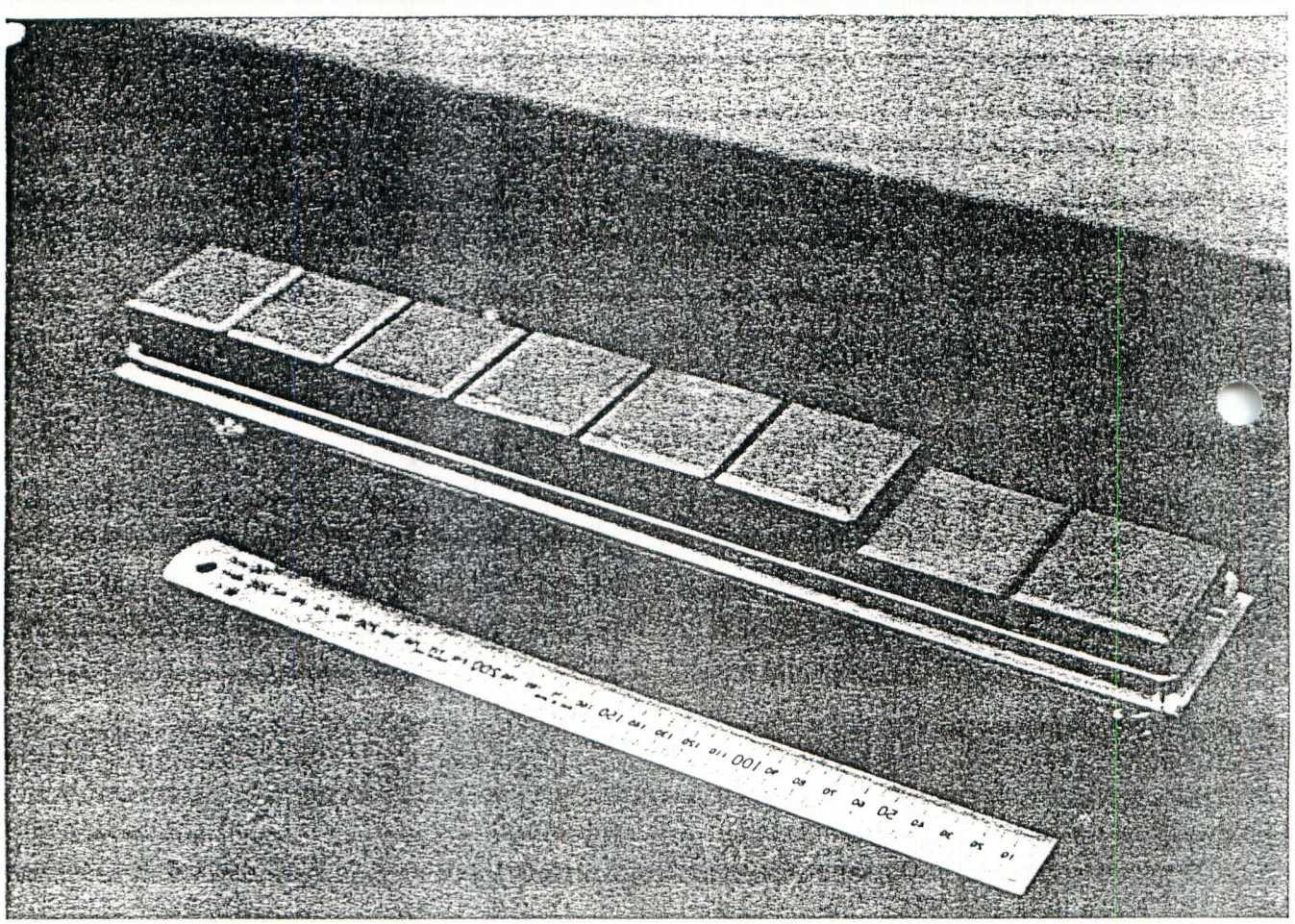


冷却板の外形寸法はＦＤＸ６９２４に準ずる。

for the production model

溝付ビームパイプ／炭化珪素高調波吸収体組立図



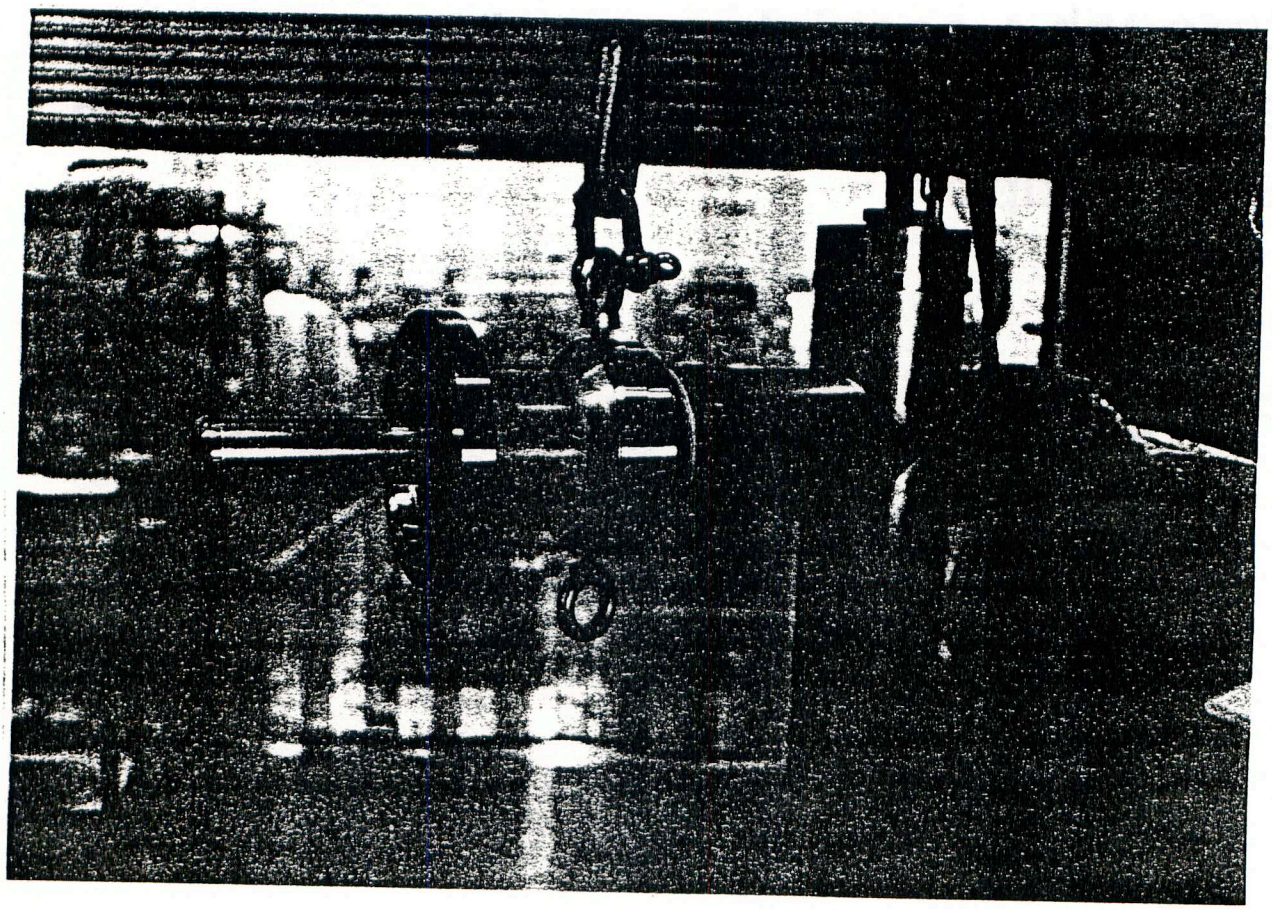


Coaxial Antenna Damper for Coupling Cavity

RF power is extracted (*Qext* ~55) through a coaxial waveguide (120D) with a disk-type ceramic window and a cross stub support.

Power capability (design < 1 kW CW)

tested up to ~ 10 kW CW



Coupling Cavity Damper

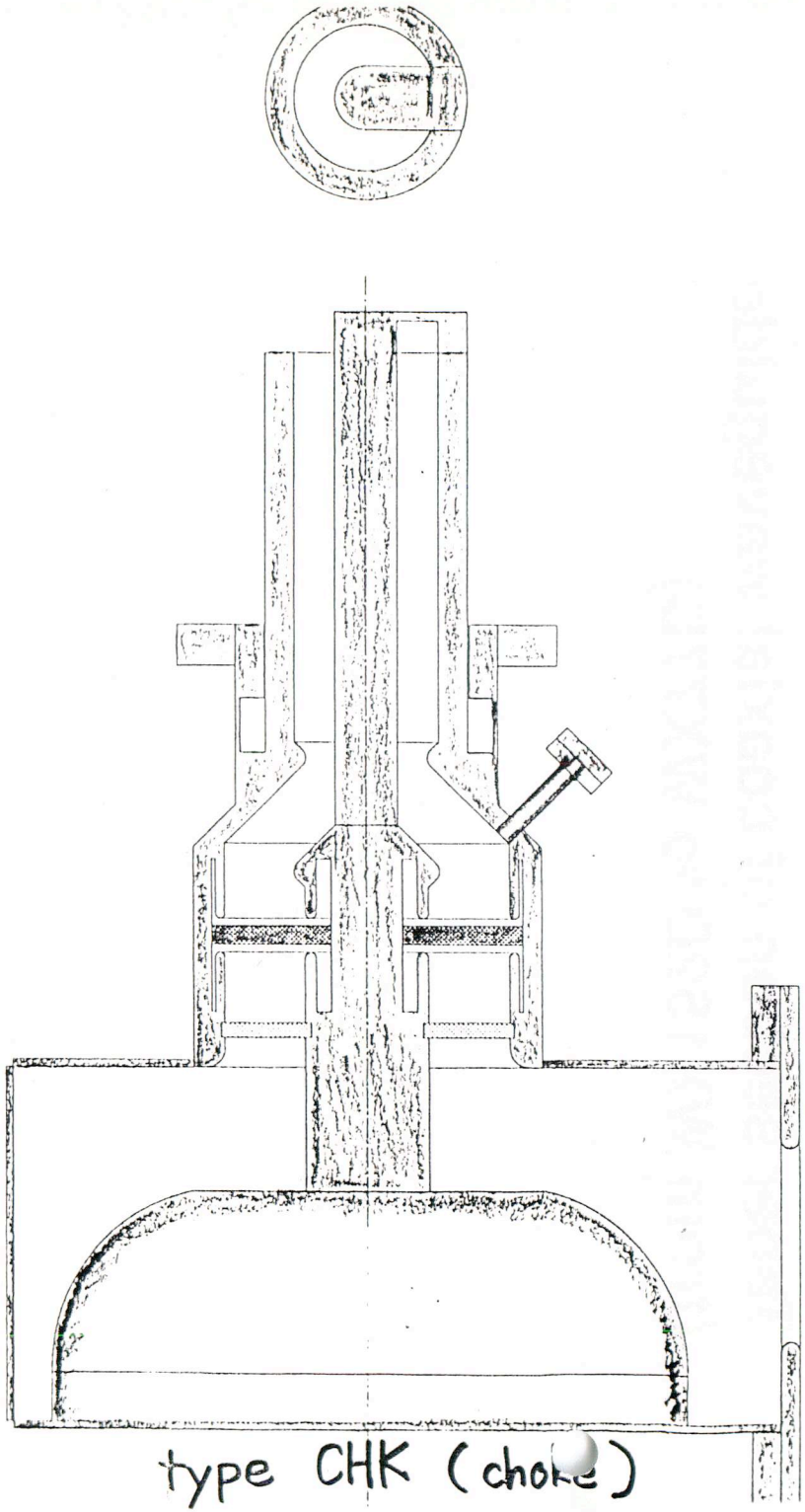
Input Coupler

Door-knob transition with a capacitive iris from the rectangular waveguide WR1500 to the coaxial waveguide WX152D

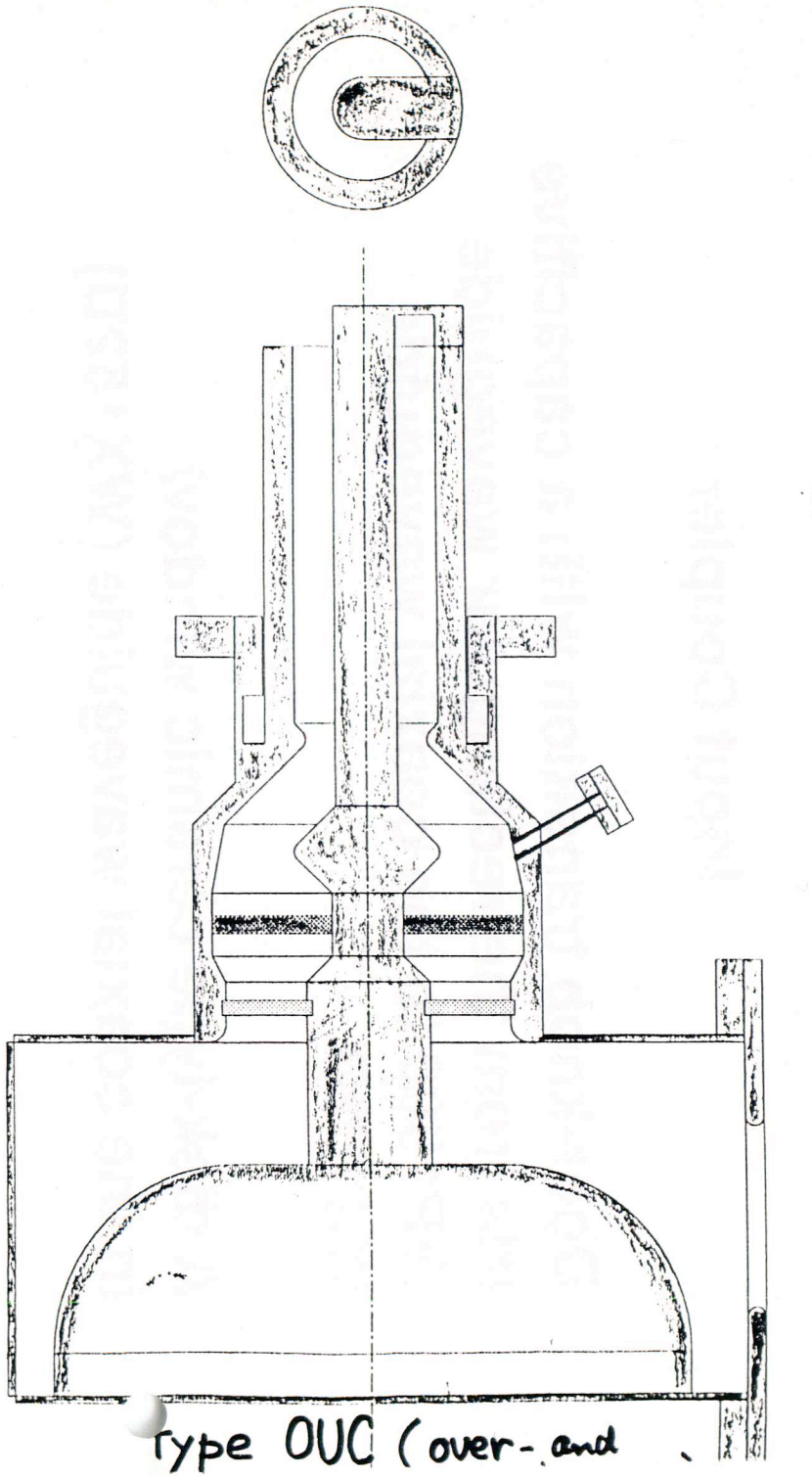
A disk-type ceramic window in the coaxial waveguide (WX152D)

Two types of window matching structures were developed.

Taper section of coaxial waveguide (from WX152D to WX77D)



type CHK (choke)



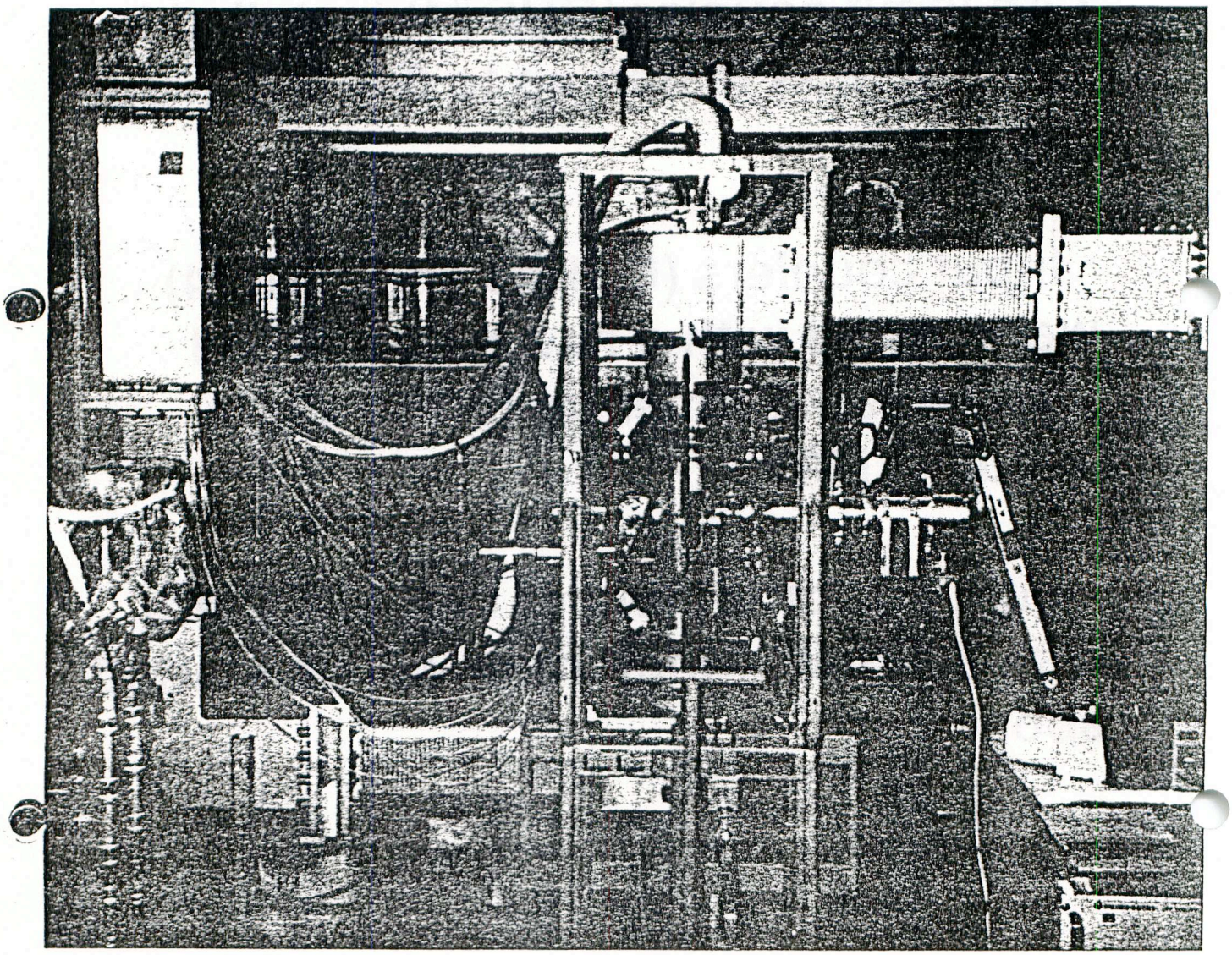
type OUC (over- and

High-Power Testing of Input Couplers

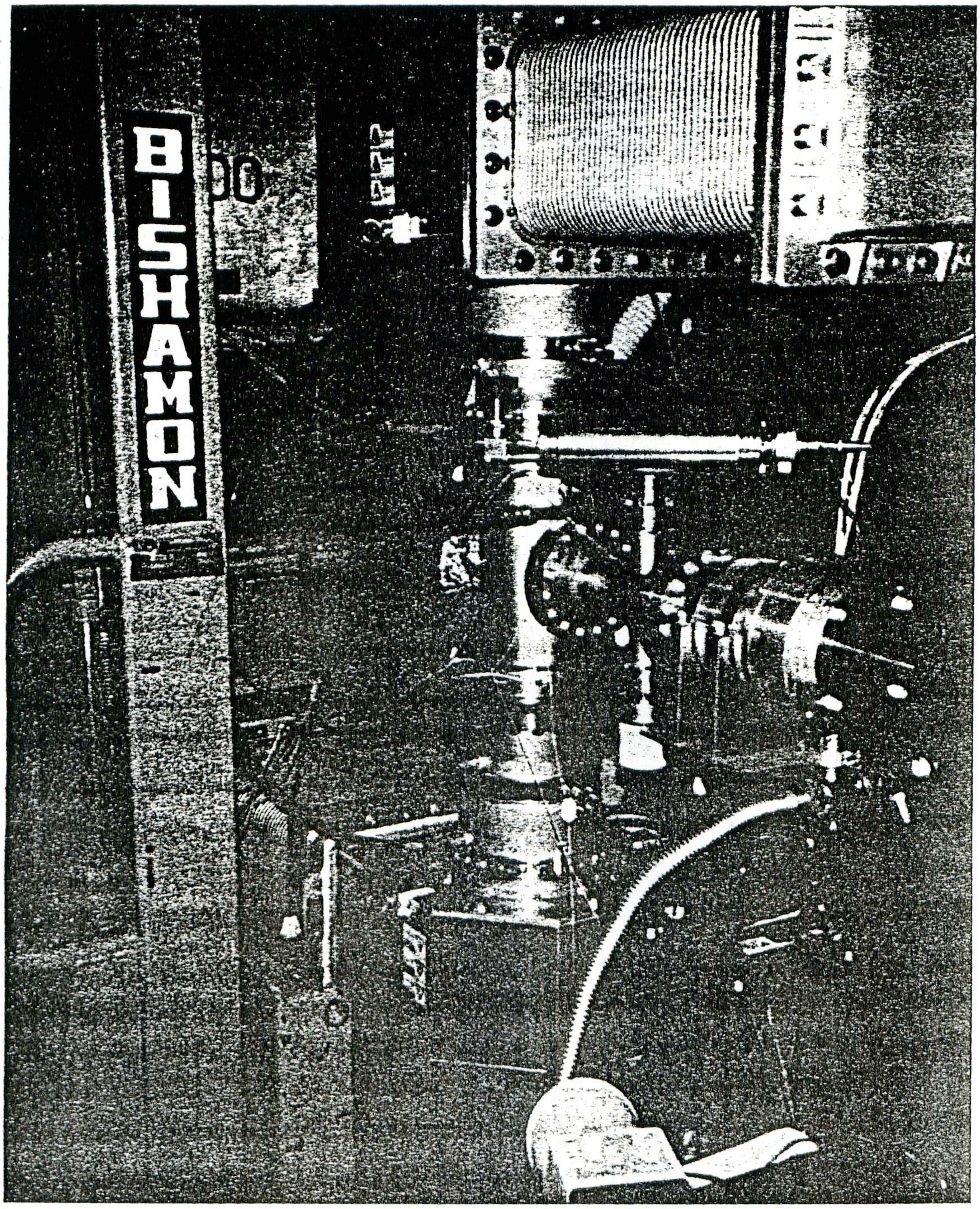
- An input coupler (OUC#4) installed in ARES96 was tested up to 640 kW in July 1997.

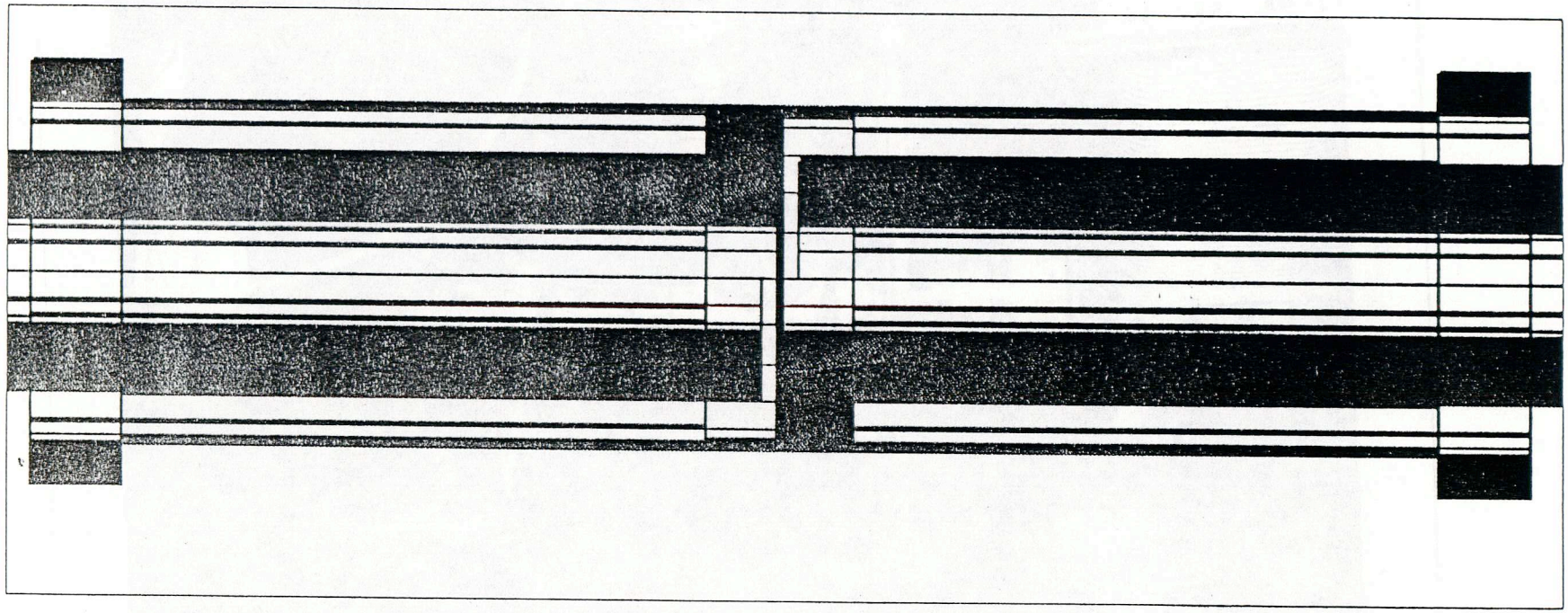
- Input couplers (CHK#3 and CHK#4) were tested with a newly developed simple transformer up to 950 kW in January 1998.

- High-power testing of OUC couplers with the new transformer will be started soon.

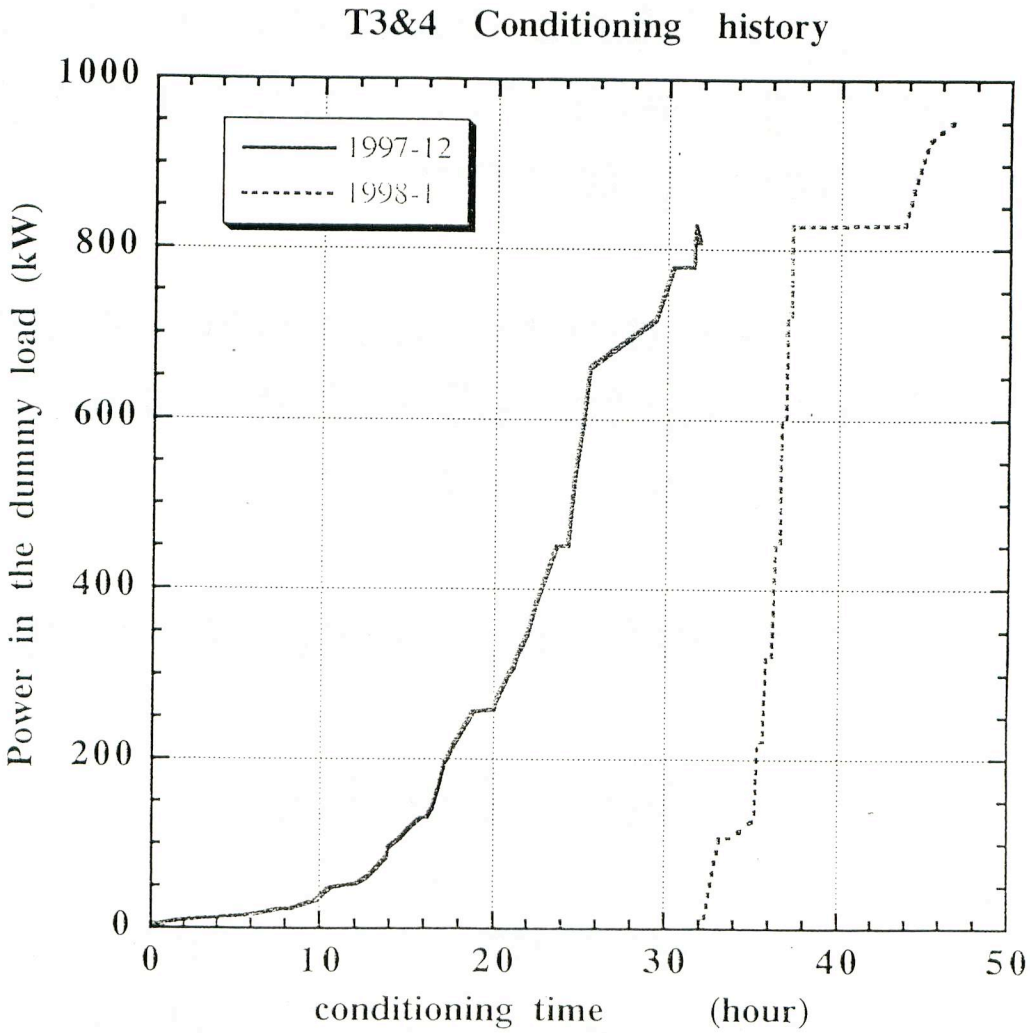


High-power test bench for input couplers


BISHAMON



A simple transformer for high-power testing
of input couplers


T3&4 Conditioning history
1997-12
1998-1
Power in the dummy load (kW)
1000
800
600
400
200
0
0
10
20
30
40
50
conditioning time (hour)

Summary

Cavity Production

- Production of 24 ARES cavities for the first stage of KEKB operation has been started. Eight ARES cavities have been constructed up to now.

- Five cavities out of them have been conditioned up to 180 kW at a dedicated high-power test bench.

- Production rate = 3~4 cavities / month

Input Couplers

- Input couplers with two different window matching structures (OUC and CHK) have been developed.

- Both types have been tested over the design RF power of ~400 kW.