ALEPH 86-114
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ectronics Crate Cooling Tests

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ations for the Aleph detector was that the equipment
eat to escape to the surrounding calorimeter.

ed to as the front end electronics box is one of 48
monolithic circuits used on the Aleph e/γ end-cap
this report were carried out using hybrid circuits
nal dissipation than monolithics.

the water supplied from the Aleph cooling system at
).1°C.

sitioned around each of the end-caps.

the calorimeter is to be maintained at 21°C.

MK II is an improved version with modifications
cooling tests on the MK I.

ss or gain to the ambient.
fficiency of the crate.

to measure the crate power then by subtracting the
he cooling water find the heat loss to the ambient.

71.03 watts ±1.0%. (See page 10, test C.)

crate voltages and currents.

the cooling water H_E can be found by:

t

specific heat of water, m is the mass of water
ure rise.

the flow rate and Δt by measuring the difference
t water temperature.

ecifies the inlet and outlet pressures to the crate
d P2 the outlet at 3 bar.

l of the crate a cooling water flow rate was
3.5 litres/min.

e specification and a check on the pressure drop
onnecting pipes.

temperature 20.8 ± 0.1°C

35mm ID 4.45 mm
.5mm ID 6 mm

= 2.7222 bar

= 0.2665 bar

= 2.9887 bar

as measured and set with a

. The flow meter accuracy

F and R refrigerated water
onal control system to
C.

ce rise of the cooling water

measure Δt to ±1.0% equal
were used;

ed to a ceramic substrate)
display (F25).

ic transducers that produce
nperature). Laser trimming
ce the device to 298.2 μA

it that gave a graphical

ernal surfaces of the box
e monitored.

ontrolled room.

Tolerances

Most of these measurements were made with thermocouples chosen for their low mass fast response characteristics. It should be remembered that ASTM and British Standards wire errors can give variations of ±2.0°C in addition to any error in the multipoint recorder. a (PM 8237A).

As thermocouple errors are in terms of absolute temperature and as our interest is in temperature difference the problem was unimportant.

Aleph Crate Cooling Tests

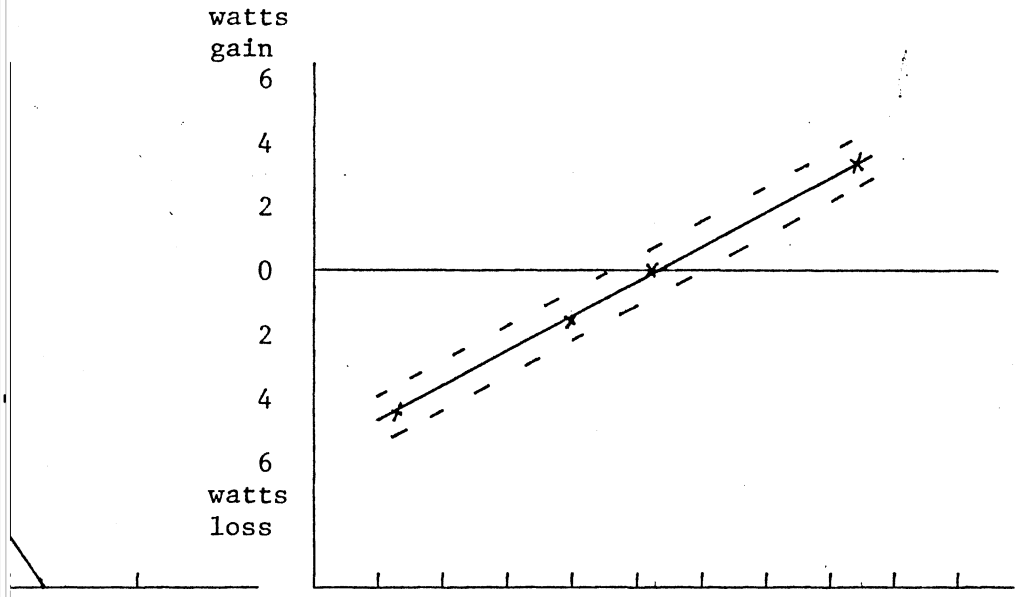


Fig 2

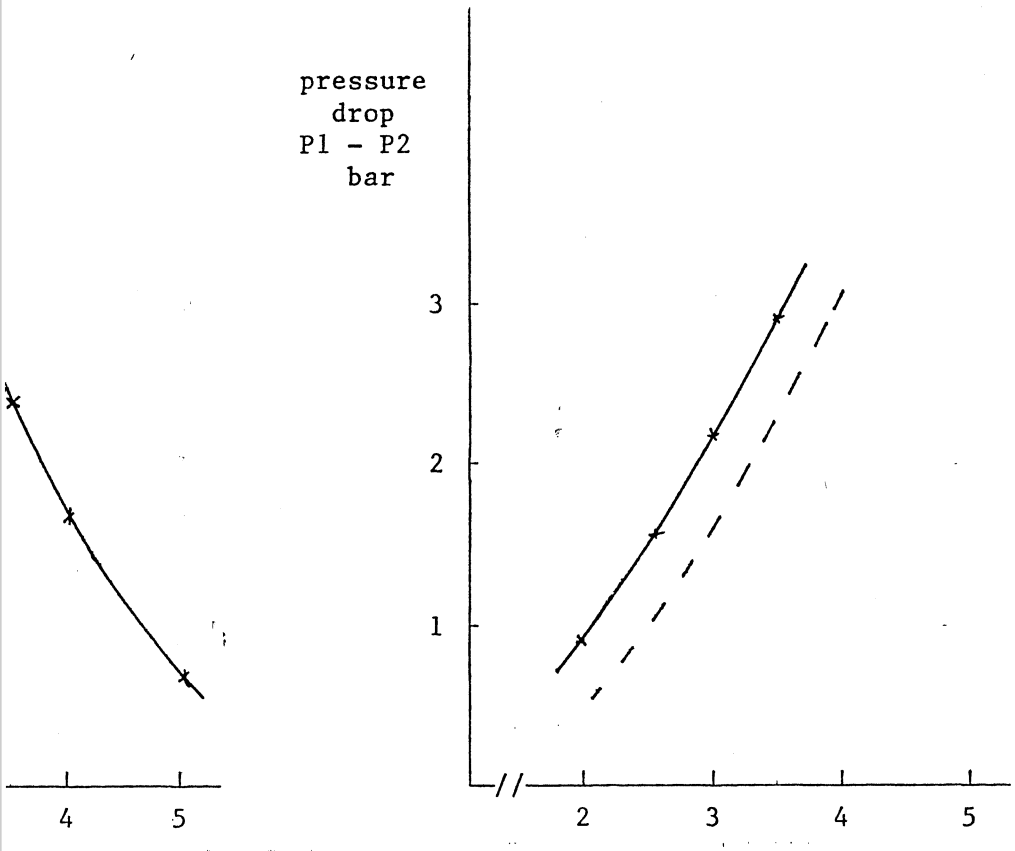


Fig 4

in various pl
atures.

red temperatu

phical form i

sfer efficien

bient, the do

re rise for v

ve for the cr

re available

and the water
on page 7, s

ons lost abou

d better insu
t water tempe

ciency improv
side.

e order of 1.

heat loss cal

the crate was

the data was
ces.

measurement
a tolerance

e the errors

conservative

e about 4.0 l

es ie on its side, inverted etc

readings plus graphs.

shown on page 4.

as a function of Δt.

ed lines indicate measurement

ious flow rates at 71.03 watts power

e and flexible pipes.

a supplement to this report, Pages 11-15.

nlet temperature and the
wing the sensor positions.

12% ie 8.5 watt to ambient.

tion reduced the loss to between 2 and 4%
ture.

when the crate was inverted but showed

watts.

lations made on the basis of radiation.

nsulated with polyurethane foam but little

n the right order now limited by

lerances to ± 1.0% and the dotted line on
±1.0% or 0.71 watts.

ch larger, and a more realistic

igure as, to date, final details of the

res/min and this will make Δt about

Problems encountered during the tests were:

1) Pulsating water pressure from the cooler unit, this appeared as noise on to Δt recording system

2) The control of the inlet cooling water temperature to $\pm 0.1°C$

3) Ambient temperature variations during the tests (long term drift).

MK II

Design Notes

Insulation Top, bottom and end

The insulation chosen was FEREX (Dunlopillo) fire retardant foam. This is a polyurathane foam with an intimate blend of alumina hydrate, a hydrate and a polymeric binder.

The grade used was DIF 194S (soft) temperature range -30 + 110°C.

This has a thermal conductivity of 0.048 watt.m°/C.

The top and rear of the crate are insulated with 6mm and the bottom 12mm thick foam. This is a low cost item approximately £1.00 per crate.

Side insulation

Space is limited here so a white melamine bonded glass fabric 1/32" thick is used. This has a thermal conductivity 0.50 watt. m°/C and the D635 burning rate is NIL. This is obtainable from AERE stores, catalogue number 16/38551 and may be glued in place.

A better insulation for the sides would be (space permitting) a 4mm twin wall polycarbonate material.

General

The inside of the crate was painted white and heat sink compound was used between the printed circuit connector support bars and the side panels.

The outside of the crate was left unpainted aluminium for low emissivity to the ambient.

Notes

Possible changes

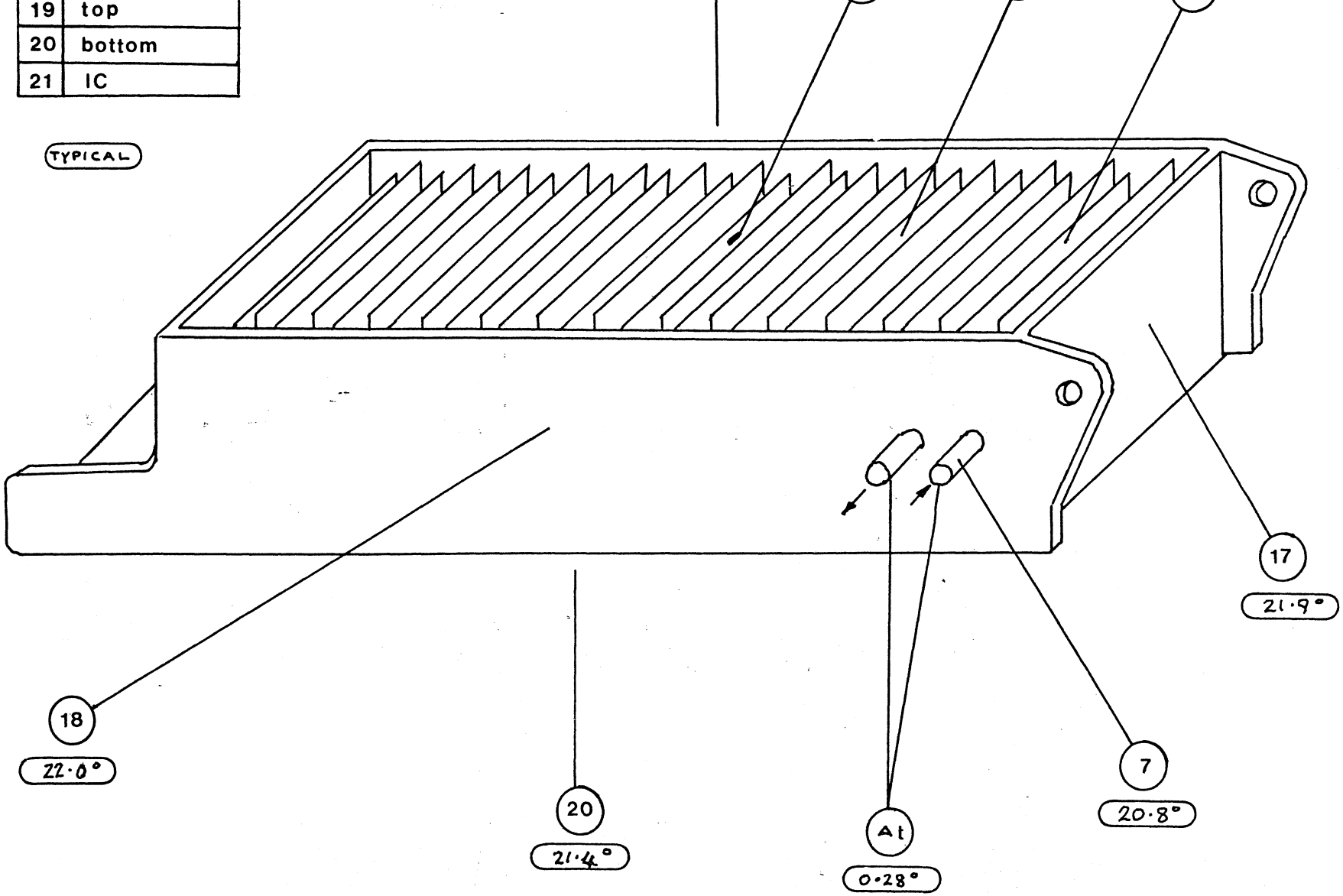
The cooling coil has enough area but thermal contact with the sides helps. At the moment this is done with brass clips and heat sink compound. A copper strip soldered to the coil would aid assembly and improve thermal contact with the side panels.

19	top
20	bottom
21	IC

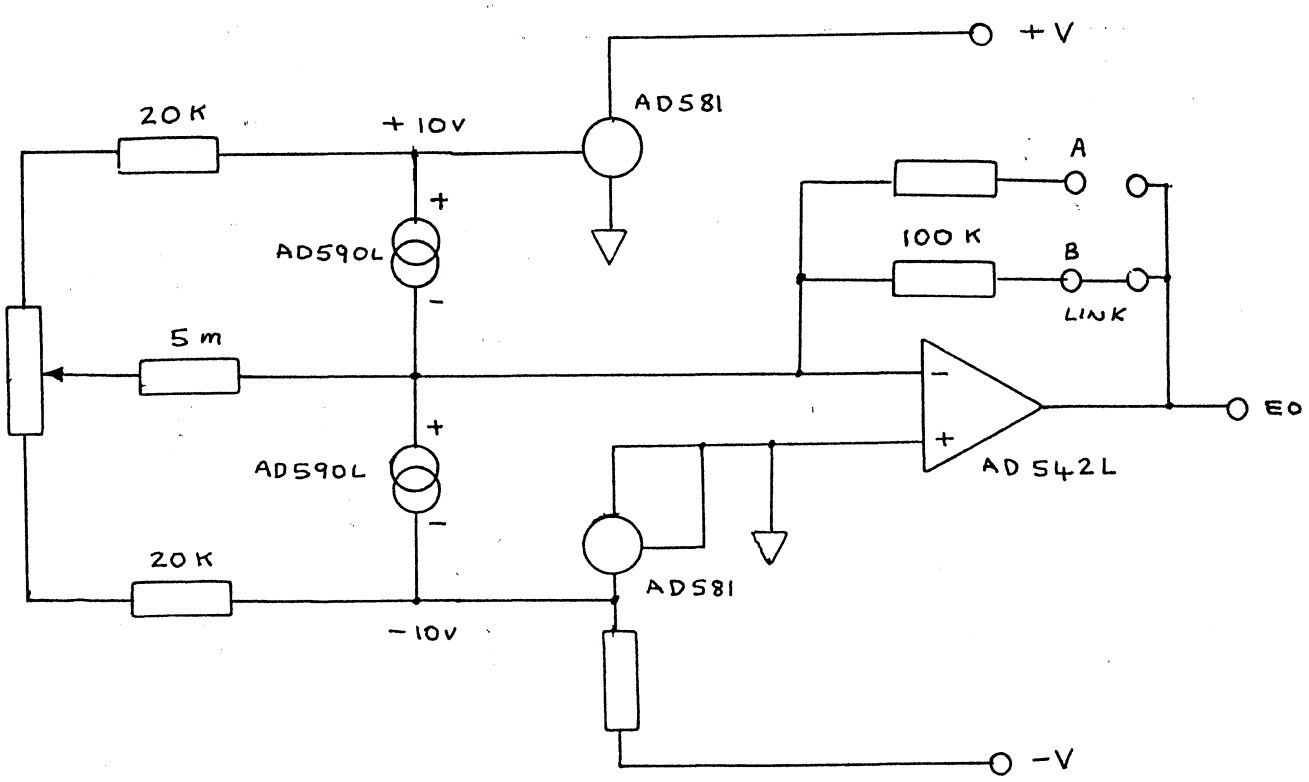
AMBIENT

21°

TYPICAL



High Resolution ΔT Measurement with AD 590's



Eo to yt Recorder

Position A	IV/°C	
Position B	100mv/°C	* This range used.

Recorder set to 100 mv FSD

The above diagram shows the circuit used to measure and record Δt.

ALEPH Cooling System Parameters	Crate Parameters
CIRCUIT EMC END CAP A OR B	24 ALEPH ELECTRONICS CRATES
HEAT 1.8 kw	HEAT 1.7 kw
FLOW 7.75 m^3/h	FLOW 5.0 - 5.76 m^3/h
INLET TEMPERATURE T2 20.8°C ± 0.1°C	INLET TEMPERATURE T2 20.8°C ± 0.1°C
OUTLET TEMPERATURE T1 21.0	OUTLET TEMPERATURE T1 20.98 - 21.18 °C
INLET PRESSURE P1 6 bar	INLET PRESSURE P1 6 bar
OUTLET PRESSURE P2 3 bar	OUTLET PRESSURE P2 2.988 bar
ND 40mm AREA 1256 □mm	ND 6mm x 24 AREA 678.5 □mm

WATTS
672
260
552
492
977
383
350
577
786
303
3
5
5
4
3

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