

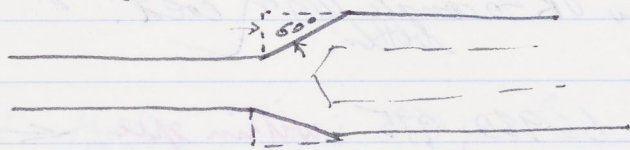
ASSEMBLY NOTES MACHINE NO 3

MINNEAPOLIS

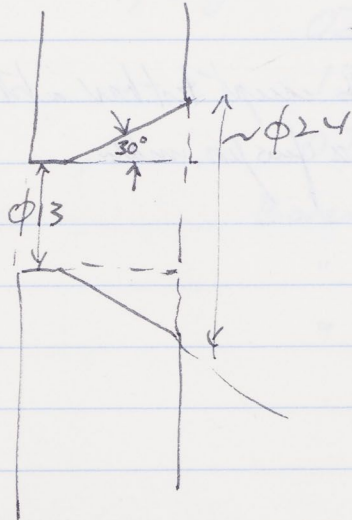


Fitting of valves

In the course of changing the panel arrang^{ts} in the housing, it turned out that the valve stem extensions would interfere with the 12mm inner panel owing to the hole now being 13 ϕ instead of the large hole in the inner 5mm panel in No. 1 & 2 machines. This can be fixed by tapering the valve stem extensions



and



protection

~~tap~~ chamfering the hole as shown. We now have 8mm of travel of the valve stem, more than enough, and there is still substantial

Tapered to 66.970 further in ^{within spec.}
0.005 out of round ←

10/5/91:
checked ^{internal} micrometer 66.995 in 66.998 standard
— micrometer OK to couple ^{ring may be a bit} _{better.} cold.

remeasured: 66.980, .975 ^{within spec} ←

Checked external micrometer — OK except test bar a bit cold, so
external measurements could be a few μ m under.

⁻⁵
10 . 70 . 5
350 . 10 ⁻⁵
~~35~~ 35 . 10 ⁻³

Dimensions as received :

3101 Top plug : OD 66.980 OK
ID 30.014 OK

3102 Top piston : OD 29.985
Piston extensions : 14.985 ; 14.990
Lower " " 14.990

4101 Bottom plug : OD seal area 66.988 }
OD ILC " 64.940 } OK
ID " " 58.010 }
OD big end 144.940 }
Bore for piston : 30.006 }
" " 42.414 outer } OK
" " 42.420 inner }

see previous page for
check on internal measurement
- OK for remeasure^{ts}.

remeasured: 66.992

66.985

983 → 987 oval

just above Oring: 66.995 66.982

.990, .985 992 in azimuth

below Oring groove: 66.910

ie up to 0.018

Near top

67.000

.987

below spec.

remeasured: 66.977

, tapered to larger & further in

.972

.970

.972

in azimuth

ie up to 0.030

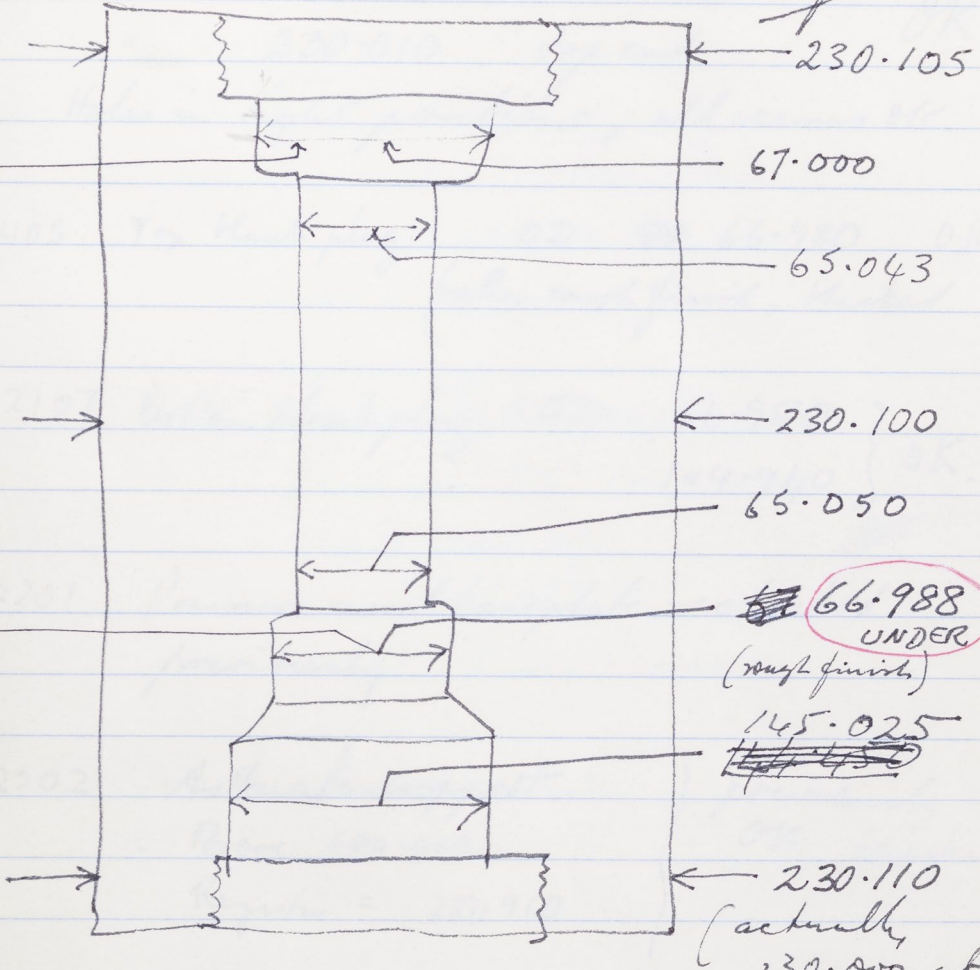
±

right in, can't get mic. out

below spec.

210/8 Pressure vessel

All within spec.



- 2103 ~~Bottom~~ ^{Top} nut fits OK
- 2104 Inner nut fits OK
- 2106 Bottom nut ~~light~~ OK, fairly snug.

2102 Pressure vessel sleeve

ID 230.030 bottom end

" 230.010 top end

OK

Holes in right positions, all seems OK.

2105 Top blank plug: OD ~~66.980~~ 66.980 OK
(rather rough finish, flaked)

2107 Bottom blank plug OD 66.980 } OK.
144.940 }

2201 Pressure vessel baseplate - checked
previously

2202 Actuator support. } previously
Bore 100.010 } OK. checked
Register = 251.910 }

2203 Bottom register ϕ ~~252.240~~ 252.095
marginally over - accept

Top register 230.050
- within spec

(this one ~~was~~ should
have been
specified
+ 0-100)

actual variation 160.105
to 160.030

2204 Stirrup

M22 Thread is tight

ϕ 30.006 top end - OK

ϕ 59.985

Smaller than spec;
may be able to live with this by
fitting in situ.

2301 - plate fitted upside down;
Thread OK this way, not
right way up
- can live with
- needs blackening

2302 Oil cylinder

Register 160.100 - 0.010
below limit

Upper end bore 130.000 } within spec.
Lower end " 130.040 }

* Needs a hone

2303 Bottom nut, oil cyl.

129.985

Nut fits OK.

5 μ m oversize
- will fit bore

2303-3 Oil cylinder piston

Dia = 130.080

(test bar)
OK

should be 129.950/129.980

— Actually made for No 2

— piston from No 2 OK here.

2304 Gas cylinder

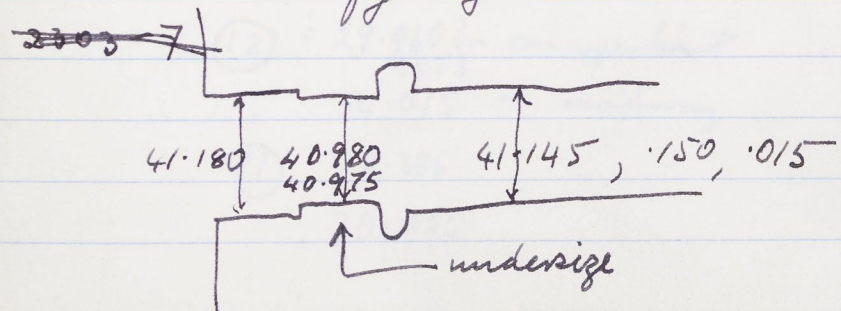
QD $\left. \begin{array}{l} 160.070 \\ 160.055 \\ 160.045 \end{array} \right\}$

OK
but out of
round.

$\left. \begin{array}{l} 160.056 \\ 160.075 \end{array} \right\}$ top end

Problem to get threads to enter oil cylinder — a lot of time spent filing off damage in thread. Thread goes OK but eccentric so doesn't enter register. To machine

2303-7 { Gas piston
 $\phi = 40.96$ OK
Bore of gas cylinder



10/1/91. Dave Ashdown talking to Sydney:

Two baseplates from No 3 for blacking

Stirrups from no 3 for connecting thread & $\phi 60$ }

Bottom plug 4101 for no 2 to correct seal ϕ

Gas piston should go in but actually catches partway ; also the clearance at the seal is too small.

* Have to hone the seal section & further in. — done at ATH & received back 27/2/91

2304 Sleeve

159.985 , 159.965 two ends
very close to lower limit — OK.

3101 Furnace plug — see earlier ; OK.

3102	Top piston	ϕ 29.985	} OK
	Piston extensions	14.985, .990	
	Bottom " "	14.990	

4101 Bottom plug — see earlier OK.

4103 Bottom piston

(10) : 29.962 — on upper limit — OK
42.370 " " — OK

(12) : 29.960 } — on upper limit OK
.955 }
54.015 — midway OK.

(17) 42.385 } OK.
30.020 }

4201 Load cell body

ϕ 53.980

Thread too tight in 4103-12

— needs chasing *

$$\alpha = 11 \cdot 10^{-6}$$

Shrinking of Sleeves

Pressure vessel	230.110	OD max	} max interference 0.100
Sleeve	230.010	ID min	

$$\frac{0.1 + 0.1 \text{ clearance}}{230} = 0.00087 \text{ strain}$$

$$\text{comp to } 79 + 25 = 104^\circ,$$

about 20° more than for no 1 vessel for which 200° was adequate. Use 220°C .

Shrinking Interference	160.075 max	} max interf. 0.110
Sleeve	159.965 min	

$$\frac{0.11 + 0.1}{160} = 0.00131 \text{ strain}$$

$$\equiv 119^\circ + 25 = 144^\circ$$

about 34° more than for no 1 for which 200° was OK, ie use 235°C

spec: $\left. \begin{array}{l} 230.100 \\ 230.060 \end{array} \right\}$

Re-measured bottom end of cylinder: 230.08 side to side
- .09 side out of round
- .115 front to back

Top of support 2203 : 230.06 side to side
 230.11 front to back
 230.00 diagonal

spec: $\left. \begin{array}{l} 230.072 \\ 230.000 \end{array} \right\}$
should be 230.100
 230.146

230.045 "

Need to note on drawing to turn after cut-outs on 2203

Winding cooling coil.

Used Duralco 132 thermal conductive cement,
three lots of 70g — right amount,
just a little left.

Used no 8 SABCO bristle brush
Went fairly well.

Intensifier oil cylinder 2302 — ground
surface a bit rough. Frank honed it
out — grinding marks showed chatter.

To accommodate the top closure of the
hydraulic actuator (2212-2) the
cylinder support 2203 had to be machined
out slightly on ID at bottom — should
make ID 174 in future.

$\phi 230.050$

Top end of cylinder support 2203 is too
small to accept pressure vessel $\phi 230.110$

Flank of thread was running out 0.3 to 0.4 (± 0.15) with respect to the bore.

OD register was more or less true to bore (within 0.02) but neither was round to better than ± 0.015 .

week of 6-5-91

Re-machining done by Frank for intensifier:

The register on oil cylinder 2302 was machined out to $\phi 160.150$ in order to allow gas cylinder to enter.

± 0.015

2304-8

eccentricity ± 0.15

Thread on gas cylinder was chased to remove ~~all~~ quality, & run freely in oil cylinder, and the O.D. & end were true up to the bore. Also the 15° lead was put on (missed in original machining)

Pressure Vessel

Neither top nor bottom plugs fit into pressure vessel, so Frank ~~had~~ honed out the ~~case~~ $\phi 67$ counterbores to

TOP: $\phi 67.020$

BOTTOM: $\phi 67.025$

Plugs then go in OK.

It turned out that the vessel bores were just below spec on more careful measurement (see fresh notes earlier), & the plugs weren't much below their upper limit, so wouldn't fit.

10/5/91

After the counterbores $\phi 67$ were corrected, it was now found that the bottom nut would not enter. Evidently there is enough closing-down under the shrink-on jacket to tighten up on the nut, which originally was fairly snug. Calculation (see 1988 book) suggests that there could be up to 0.027 mm of closing-down as the interference was a bit more than previously.

So Frank set up the nut & took off a little from the thread (which was a bit out-of-round too), so that the nut now goes in freely. Thread finish is not as good as ideally but should be OK.

Prior bore:

65.05 below seal

65.02 50 mm down

16-5-91

First pressurization

Set both digital meters to zero

Heise reading 150 = 15 MPa

Pumped to Heise 80 MPa.

Bourdon gauge about 70 MPa

Newport meter reading 1.1, ie a factor of about 100x low.

~~"Signal input" to meter 100 mV → 100 mV~~

Changed config of strain gauge board to $S1 = E$.

Re-zeroed dig. gauges; Heise zero OK.

Pumped to Heise = 92.1 MPa

set gain → 92.1 on both DVMs

Bourdon about 85 MPa.

<u>Heise</u>	DVM intensif	DVM vessel	Bourdon
--------------	--------------	------------	---------

0	0	0	0
92.1	92.1	92.1	85

after standing for ~ 1h

90.0	91.6	92.1	82
------	------	------	----

back to zero to try to get intensif pump working

0	0.0 0.0	0.4	0
0	0.0	0.0	0

14.0	13.4	13.4	0
------	------	------	---

0.0	0.0	0.0	0
-----	-----	-----	---

10-2-21

First measurement

At both digital meters to gas

Base reading 100 = 10 MPa

Pressure to strain 80 MPa

Pressure gauge about 10 MPa

Height when reading 1.1 is a factor

about 100 x 100

1 2

~~Height of top of column~~

2 4

4 8

Change of strain gauge bond to 21-E

Re-groove the gauges; strain gauge OK

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

5 10

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Pressure to strain = 22.1 MPa

Intensified but now fairly bad

bottle pressure

Heise	DVM intensif	DVM vessel	Barometer
13.6	13.2	13.3	0

Gas pump.

104.8	104.1	104.1	98
-------	-------	-------	----

Intensifier

197.2	199.4	199.4	192
299.2	304.0	303.6	294
394.4	402.2	401.5	387

Some bubbling from intensifier

~~Y~~ Control setting on Vessel won't go above 487. At 500, still some bubbling from intensif

491.0	501.0	500.3	494
493.0	503.5	} about 0.9 lower	
490.0	500.4		

pressure dropping at mod rate — must be leak somewhere in encers of intensif, maybe gauge.

Repumped to 500, closed intensif out valve. Leak is in intensif circuit, still could be Heise. Dropped to

391 reset to	400.7	400.1	} cal now OK.
388.0	388.0	388.0	
385.0	385.3	385.3	
384.0 400.0	383.6	399.9	

Diam : 65.055 below seal

65.025 50mm down

/so stretch = 0.005 at 500 MPa

Dropped pressure

Heise	DVM intensif	DVM vessel	Bourdon
about -3 at first (T. eff. put?)	0.003 -0.3	0.001 +0.1	0
came back to about -1	-0.2	+0.2	

Measured bore — see left.

Put Disogrin O-ring in intensifier
Reset zeroes :

0.0	0.0	0.0	0
Bottle pressure			
13.7	12.6	12.7	0
{ 102.0	98.3	98.2	95
{ 101.2	97.9	97.8	"
{ 203.0	198.9	198.7	195
{ 201.2	198.0	198.1	
{ 304.2	300.0	299.8	295
{ 302.0	298.6	298.5	
{ 404.0	401.3	400.9	400(-)
{ 401.3	398.8	398.4	
{ 506	502.8	500(+)	500(+)
{ 498	494.7	.	
{ 402.8	400.7	400.3	385
{ 398.5	396.3	395.9	
{ 308.8	306.9	306.8	295
{ 308.2	306.4	306.3	

Heise	DVM _{intens.}	DVM _{remd}	Bourdon
{ 210.5	209.1	209.2	200
{ 210.5	209.0	209.1	
{ 110.8	109.5	109.8	105
{ 111.3	109.7	110.0	.
{ ~-1.5	-0.1	0.0	0
{ ~-2	-0.1	0.0	
{ ~-1	0.0	0.0	

17/5/91

Removed Heise gauge & put in blank
 Pressure gauges take a while to settle down. After
 a few minutes:

-1.4	0.5	0
-1.3	0.5	0
-1.1	0.5	0
-0.9 $\Delta = 1.4$	0.5	0

Opened bottle

11.3	12.8	0(+)
------	------	------

Pumped on gas pump to

94.3	95.6	90(+)
------	------	-------

Pumped on intensifier to 520

501.3	500.0	500
-------	-------	-----

dropping too fast, must be small leak
 At 550 leak = pumping rate

DVM intensif DVM vent

Back to room pressure

Leak at 4-way connection to intensif p gauge.
Tightened.

	- 0.4	$\Delta = 0.8$	+ 0.4	0
Bottle pressure	11.4		12.8	0(+)

Gas pump, then intensifier
Not too bad at 500

Intensif leak at 600

~~600~~

~~620~~

616.5

618.0

Sprung a leak at ~ 650 . Leak at
entry to 4-way from Intensifier Out valve.
Tightened.

	+ 0.1	+ 0.3	0
Bottle:	11.7	11.8	0(+)

Intensif leak ~ 550

Larger leak at ~ 670 . Back of gas
release valve.

Back to	0.7	0.3
---------	-----	-----

Left switched on over night. Next morning
zeroes: - 0.1 + 0.4

Setpoint on Newport Meter Q9201S

As supplied, max setpoint was about 486.0 with standard config
SR1 = B F I M on pinforest 55
(p39 of book).

Changed to SR5 = C G J K
0/1V range.

Now max setpoint $\sim$ ~~4~~ 240, i.e.
half before.

Tried 0/2V, SR6 = C F J M
Now can get up to 525

Talked to Mike Farkas, AMS — he can't
see any reason & suspects a fault.
Can either send back to them (not really
time) or contact Newport in Minneapolis.

20 to 22/5/91

Machine moved for photography.

Plot of measurements 4 pages back
gives $454 \text{ Heise} \equiv 450 \text{ DVM int'cal}$
so the meters are reset opposite
to bring these numbers into
agreement

Pressure test to 725 MPa

22/5/91

Continue Pressure Testing

Reset zeroes on meters

	DVM intensifier	DVM vessel
	- 000 000.0	- 000.0 wandering up still?
Bottle	11.3	11.4
Gas booster	91	91
Intensifier	450.2	450.0
	reset to 454.2	reset to 454.0

ie calibration should now be OK
 slow leak at 625, max reached due to air pressure,
 leaked back to 606 in couple minutes or so

675 - intensifier leak started.

680 sprang a leak.

Appears to be a gross leak at entry to vessel
 & a smaller to intensifier.

Zeros:	- 000.1	+ 000.4
	- 000.1	000.5

Bottle	11.0	11.6
Gas booster	~ 97	~ 97

Intensifier leak started again ~ 625

Went to

725

 sprang a leak. at entry to vessel p. gauge.

New zeroes:	000.0	004.9
		↑ substantial zero shift

Left overnight

Next morning	000.4	000.7
	reset to 000.0	000.0 after overnight running

Main reservation - pressure vessel pressure gauge
zero moves around much more than the
intensifier gauge reading - seems to be
more temperature sensitive or something.

Pressure bore after 725 MPa:

Just below O-ring	65.06	-	incr	0.010
50 mm down	65.045	-	incr	0.025

Put ~~new~~ 700 MPa rupture disk in & retested

320:	DVM _{intens} = -0.1	DVM _{normal} = +0.4	
bottle	-0.2	+0.8	$\Delta = 1$
bottle	10.5	11.7	

Up to 600: 600.0

600.9

Back to

Only very small leak at intensifier,
intermittent.

Holding pretty well after thermal
finished. Dropped 0.7 MPa in 1 minute
on v. small volume.

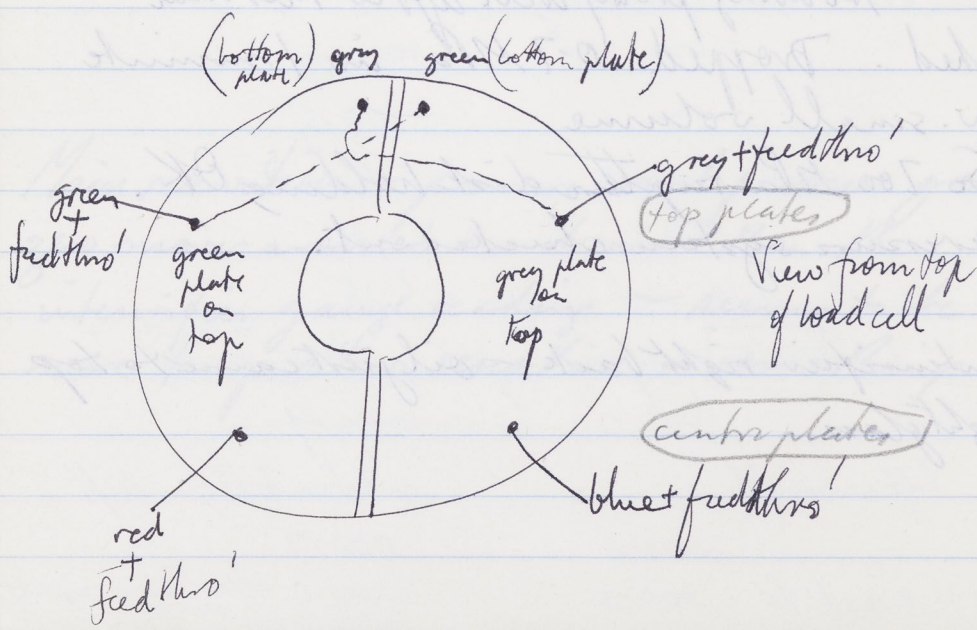
So 700 MPa rupture disk holding OK.

— pressure system checked out.

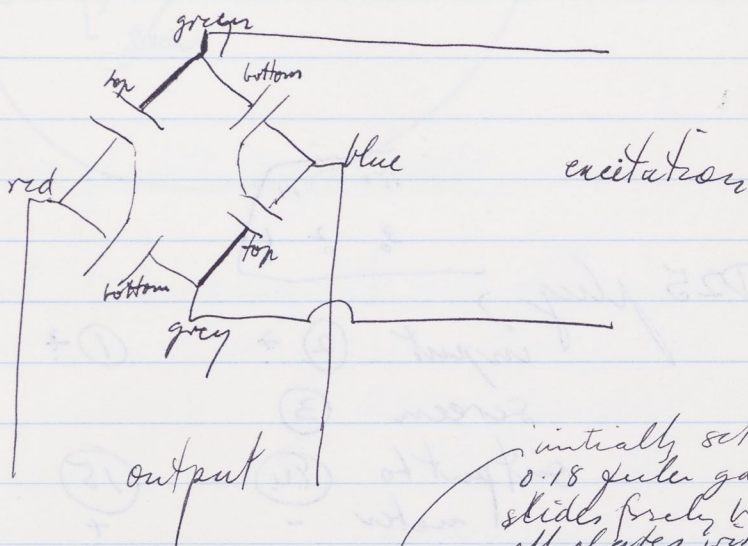
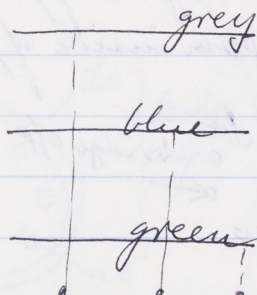
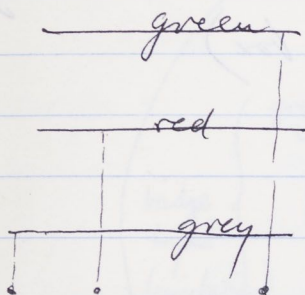
Set intensifier right back - oil just came to top
of sight glass.

Two reservations about this load cell:

- 1) finish in feed-through seatings
- 2) screwholes for screws holding centre plate not tapped quite vertically — had to use loose screws & fits to assemble OK.

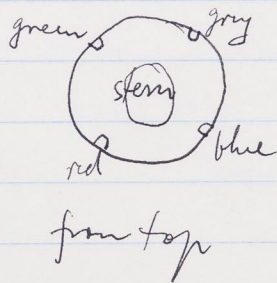
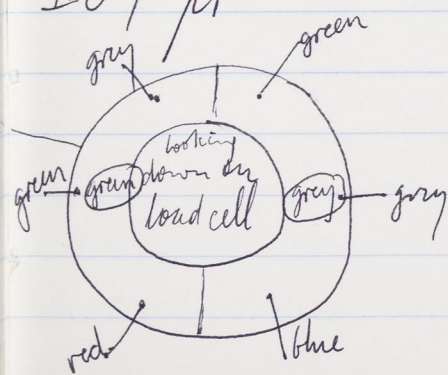


Internal Load Cell

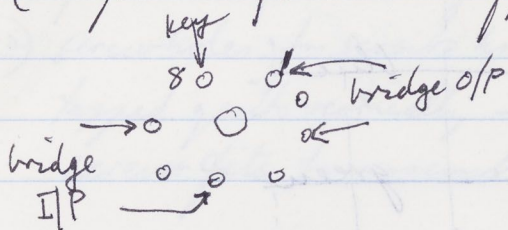


Adjusted capacitances on the pins on plates before connecting up. All equal to 48.4 ± 0.1 pF

initially set so
0.18 guler ganges
slides freely between
all plates with minor
film between



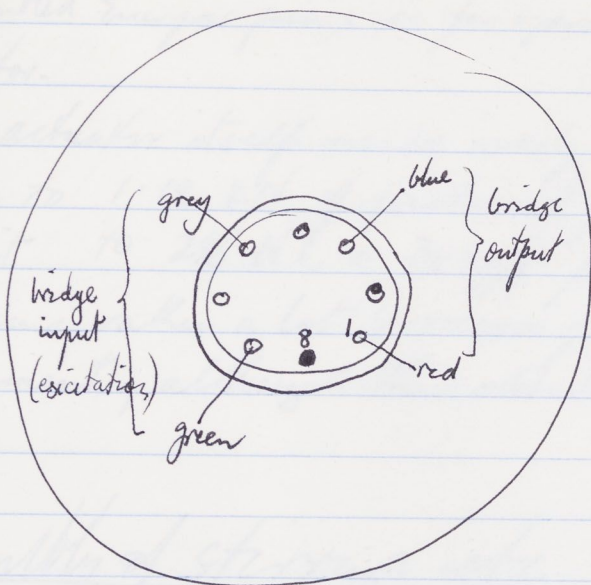
Allen's "rear view" diagram of plug, ie look at the wiring side (or upwards from inside of preamp box)



On D25 plug,

15	0.14
3	2 1
0	0

input (2) $\rightarrow$ (1) $\rightarrow$
screen (3)
output to meter (14) - (15) +



Looking
into the
preamplifier
box.

(again
looking
down)

Assembled Enerpac pump etc for operating hydraulic actuators.

The actuator itself needs nearly 50 psi oil pressure, corresp to 1.18 kN of frictional force to operate, eqvnt to 296 N or 30 kgf per seal,

— seems rather a lot & raises question of alignment, although this should be OK.

24/5/91

Assembly of stirrup etc

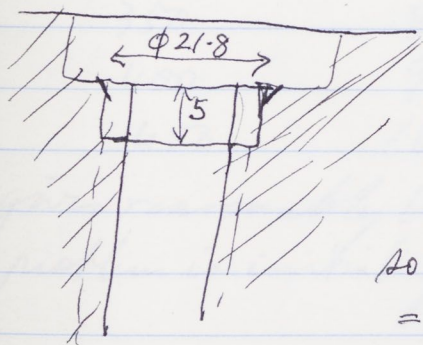
Failed to assemble — the nut on the $\frac{3}{8}$ " tubing/rod connecting the bottom pistons, of $\phi 20$, failed to pass through the "M22" thread on the stirrup. Measurement showed the thread to be actually M21.6 $\times$ 2.5, with minor diameter = 19.5.

Actually on checking standard sizes, an M22 thread should have a minor diameter of 19.3, so this should not have passed the $\phi 20$ nut on the other two machines. How did they happen to assemble OK?

Since the thread in the stirrup has approx the right minor diameter (actually a little over) but a shallower depth of thread than it should, we cannot risk to open up the minor diameter.

Therefore, we sleeve back the preamplifier housing & reduce the diameter of the retaining nut to $\phi 19$.

Then found that the stirrup was not screwing right up to shoulder on the piston - the thread had not been cut to the end. So had to relieve the thread for 5 mm,



leaving about 15 mm of thread.

With $PC \phi \approx 20$,

$$\text{area of thread} = \pi \cdot 20 \cdot 15 \text{ mm}^2$$

so strength with 800 MPa yield

$$= \frac{800}{2} \cdot \pi \cdot 20 \cdot 15$$

$$= 377000 \text{ N}$$

$$= 377 \text{ kN}$$

against design max. of 100 kN

$$100 \text{ psi} = 2.37 \text{ kN}$$

Internal load cell test:

At atmospheric pressure, with 5V 5kHz excitation from internal source, & reading output on Fluke meter, get a zero reading (very sensitive to body movement) of $\sim 26 \text{ mV}$.

Cycled load:

25 0	psi $\equiv$ 0 kN	25.9
100	2.37 kN	25.3
150	3.6 "	24.8
200	4.7 "	24.3
250	5.9 "	23.6
300	7.1 "	23.1
350	8.3 "	22.6
400	9.5 "	22.0
450	10.7 "	21.5

gives reasonably linear plot. Main problem is initial offset.

Range of zero adjust is $75 \text{ mV} \rightarrow 46 \text{ mV}$
i.e. approx $\pm 15 \text{ mV}$

(zero now diff because meter moved.)

Meter indicating 6 mV with no excitation

Meter zero (leads shorted) $\sim 1.0 \text{ mV}$

Load all balance seems to have changed. Measured on pins in H space:

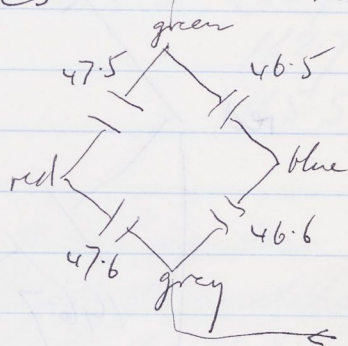
Red - blue	150	
- green	188	191
- grey	262	
Blue - green	239	
- grey	257	
Green - grey	240	

Disconnected all plates

25/5/91
exit.

Red - green	47.5
Red - grey	47.6

Blue - grey	46.6
Blue - green	46.5

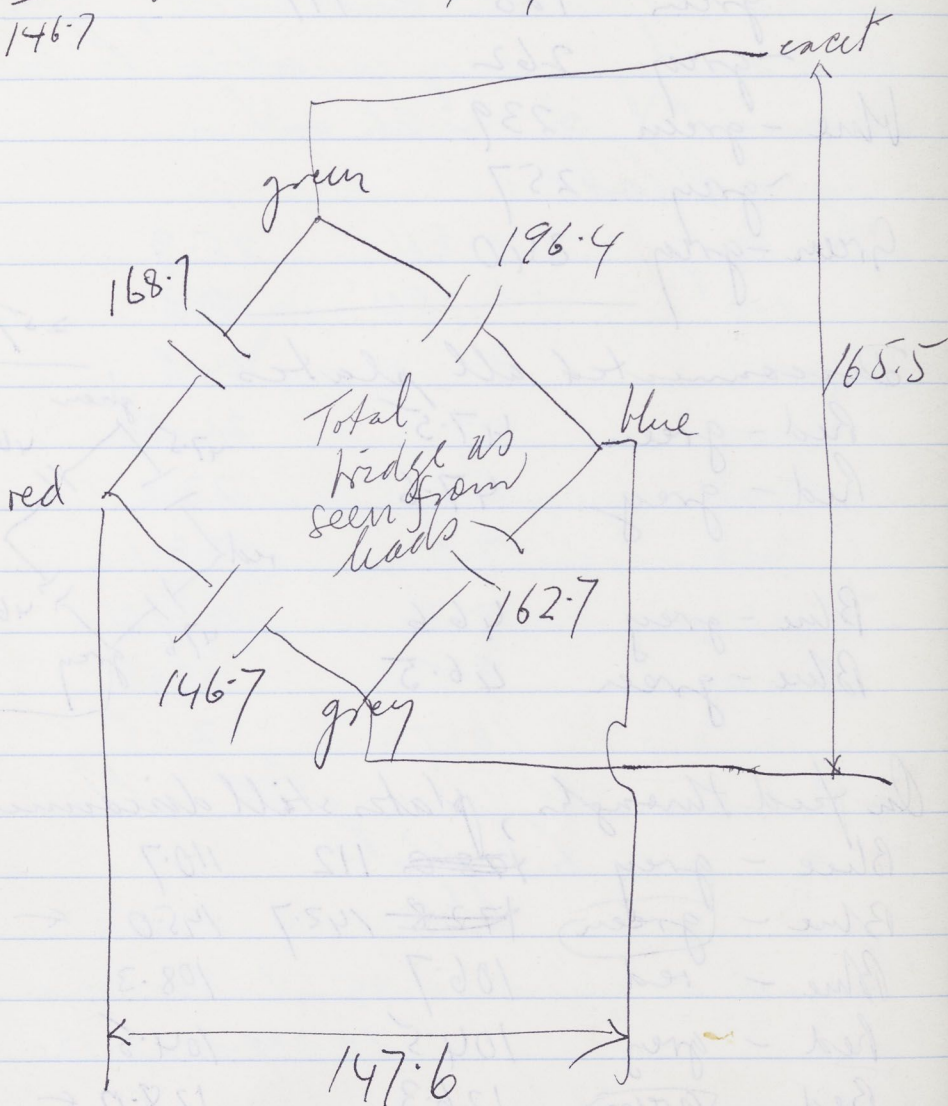


On feed throughs, plates still disconnected

Blue - grey	178.0 112	110.7
Blue - <u>green</u>	172.8 142.7	145.0 ←
Blue - red	106.7	108.3
Red - grey	104.5	104.5
Red - <u>green</u>	126.3	128.0 ←
<u>Green</u> - grey	185.0 131.0	127.4 ←

$$\frac{168.7}{146.7} = 1.150$$

$$\frac{196.4}{162.7} = 1.207$$



Earth - Blue - ~~183.7~~ 183.7
 - Red 176.9
 - Green 173.9
 - Grey 178.8

Reconnected all wires, measured on Red thro's

Red - Blue	146.6 146.8	144.2	147.6
- green		163.6	168.7
- grey	145.6	146.8	146.7
Blue - green	198.1	197.3	(196.4)
- grey			162.7
Green - grey			165.5

Reassembled in bottom plug & set up on base at back of machine. Put 5kHz 5V excitation on & measured with Fluke (zero = 1 mV)

Reading = 14.0 ~~14.0~~ mV, depending a bit still on my position without power on.

With power : 982 mV

932 " with capacitor at one end

1118 " at other end

Took out again

NOTE ON TRANSFORMER.

The blue/red wires on 5, 6 / 7, 8 ~~go~~ = 100052 goes to Inston, carrying the signal input to Inston.

1, 2 / 3, 4 have to be connected to pins 14, 15 on D25 plug

Connect if reading is ridiculous (means common is going to ground)

(Their pin 3 should go to ground & there shouldn't be a problem)

Note on Newport control

S3 jumper on main circuit board placed on in order to get full span.

Disconnected plates again.
Resistances to earth

Red	0.757	MR
Blue	2.003	MR
grey	0.685	MR
green	0.198	MR

Disconnected stem wiring (at press.
side of feed thro's)

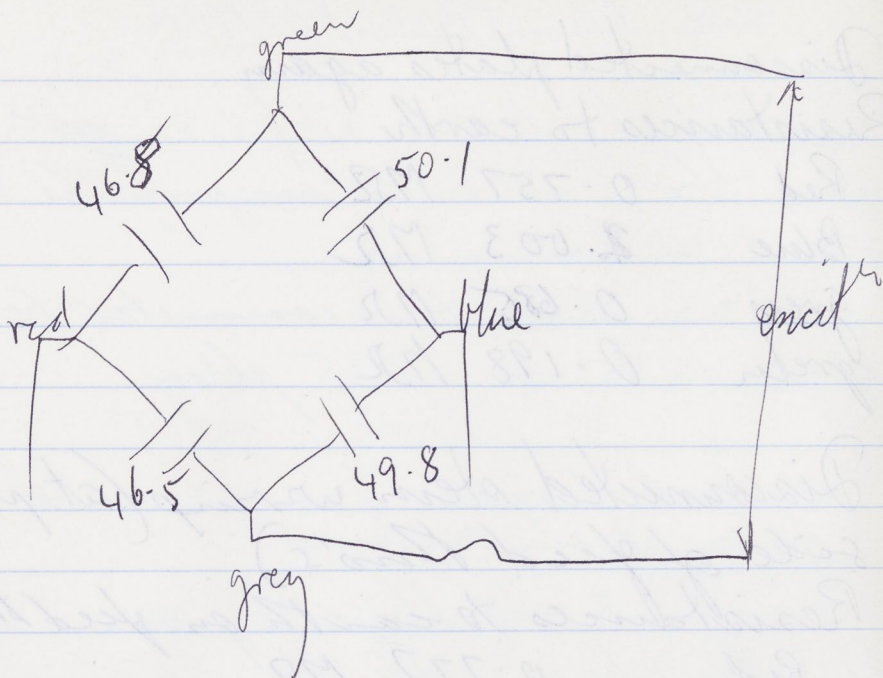
Resistances to earth on feed thro's:

Red	0.777	MR
Blue	2.056	MR
Grey	0.667	MR
Green	0.215	MR

Wires on stem give OL
Insulation OL

Conclusion: Forgot to specify Disogrin Orings
instead of black ordinary.

Changed all Orings & reassembled.
Resistance to earth at each feed thro'
now open circuit.



Readjusted plates before wiring:

blue - black 49.8

blue - green 50.1

red - green 46.8

red - gray 46.5

Connected up, with meter on output.
Even with excitation disconnected,
there is an output of 0.54 V (varies
from 340 mV to 1.8 V depending on
trimming capacitor).

Lifted off pre-amp $\rightarrow$ 180 mV.

(~ 32 mV without power on preamp)

Checked load cell again - no plates shorted to
earth or each other. Capacitances

Red - blue 146.6

147.0

- green 134.2

134.2

- gray 136.5

136.8

blue - green 135.3

135.5

- gray 134.7

132.8

green - gray ~~129.2~~ 127.2

127.5

in
merchandise

seen OK.

meters in diff
position

Coming back
toat- from.

145.7

131.8

135.0

133.8

130.6

127.2

Removed the lead on D25 connected & measured voltage directly on pin — 0.71 V , so problem is not picked up by the lead.

Put lead back on — 0.79 V

Twisted ~~inc~~ excitation (black/white & shield) together — 0.937 V (same when clip on earth)

" earthed bottom plug — 255 mV when take preamp off ~~plug~~ ILC (same when isolated, as earthed)

— 54 mV when ~~take~~ unplug lead into preamp.

(80 mV power off)

Installed in machine, with leads to ILC Resistances OK.

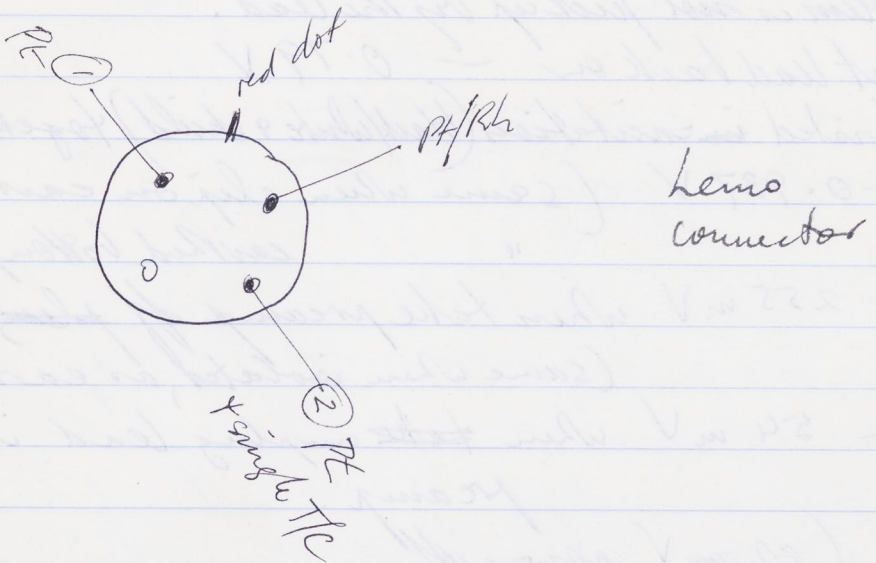
Capac:	at. pres	10 MPa	100 MPa	200 MPa	300 MPa	500 MPa
red-blue	146.4	149.7	163.0	167.4	170.1	172.9
— green	133.4	136.9	152.7	157.6	160.3	163.7
— grey	136.2	139.8	155.2	160.6	163.4	166.8
blue-green	134.9	138.6	154.5	160.0	162.9	166.3
— grey	132.4	135.8	151.1	155.2	158.6	162.0
green-grey	126.8	129.1	140.1	143.5	145.6	147.8

piston friction psi
— fuel

~250
~150
100
2.4 kN

~400 500 700
150 150
250 550
5.9 kN 8.3 13.0

Looking down on T/C



ILC OK at 500 MPa in cap. & resist, & no leaks.

Test on ~~top~~ furnace plug with dummy piston.

Took to 408 MPa, no bubbles (ran out of interinf stroke).

Tested out furnace circuits with 25 Ω resistance in turn on the three windings. (L $\rightarrow$ R of thermistors & fuses are TOP, CENTRE, and BOTTOM).

May need to check thermocouple connector for ① & ② (see oppo.)

Instron attach^t screws need to
be $6\frac{1}{2}$ " max ≈ 165
[160 would do].

Depth of thread in Instron was $\sim 3/4$ "
ie ~ 019

10/6/91

Installation: Some confusion in morning
because main crate arrived in a covered
truck, end on & it was not clear how to get it
out (or how they got it in). However, around 10am
the moving man Tom arrived with truck & equipt
& soon got it out after decrating. Got it
onto corner wheels, down lift, along corridor,
up another lift & into lab by lunchtime.

In afternoon, put in actuator — some
problem with bolts too long, & had to
shorten them (see above), but finally in
place.

11/6/91

Uprighted the machine using an A-frame &
two block & tackles lifting on the lower eyebolts
(limited headroom). When approaching neutral
position, put steadying blocks under the free
legs & with ~ 20 mm gap pushed machine

by hand through neutral. Then with jacks
let the machine down in small stages on
to these legs, after "walking" it into the
approx final position. All this time, the
floor was covered with plywood panels from the
crate, which was taken out near the end. The
A-frame was in wheels so it followed the machine.
After the machine was in place, an extra
linco tile was put under the LH back leg.
The guide post of the Inston actuator was
very near the floor, clearance $\sim 3-4$ mm.
Also attached platform, desk etc.

12/6/91

Mainly finer details, tightening actuator bolts
etc. Pumped up to 400 MPa in afternoon
after argon connected & air. Water also
connected today.

2.45

After assembly, contact point at bottom position is -2.5 mm

No pressure friction $\sim 0.1 \text{ kN}$ upwards
 ~ 0.06 down "

Contact at top position is -30.0 mm

When turned on 1kC, noisy at $\sim +3 \text{ kN}$.
This went to near zero when actuator turned on, still noisy.

Tried to calibrate without much success. Reading went up with load but wrong polarity & not enough — would not calib.

Inspected plug from Instron — terminal 14 ~~con~~ (output +) seemed to be not in place properly in plug; also opposite sign to that given by Instron.

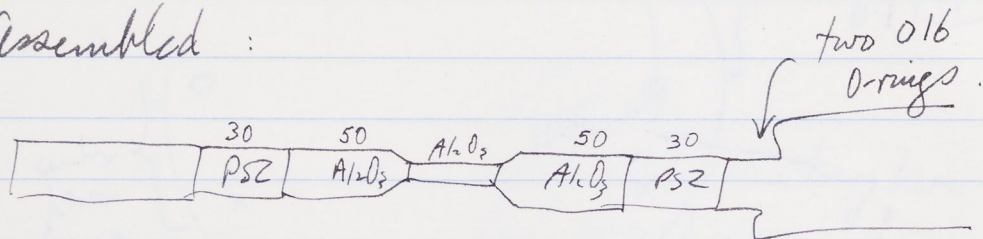
Pushed terminal into plug better. Now reading steady but about 67 kN .

15/6/91

Put in furnace

- no #4, 5 & 6 thermocouples backwards,
so changed over at junction inside cabinet,
now red-black, black-red.

Assembled :



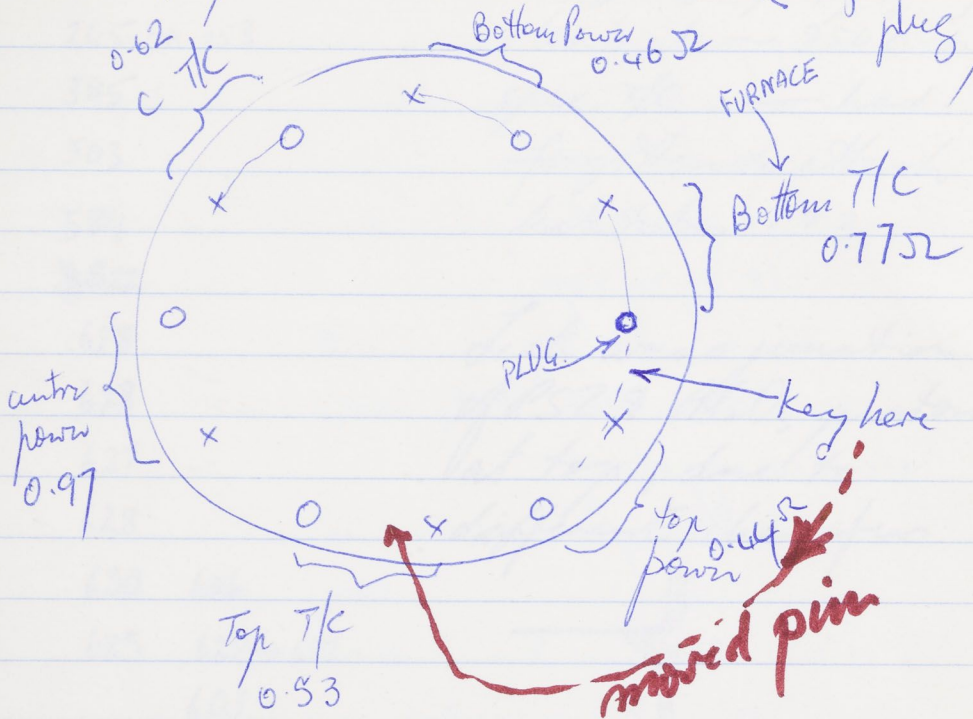
(T/C would not go through 85 Al_2O_3 pistons
— hole off centre > clearance).

Set current limits on bottom & centre but
when tried to set top, at first no response,
then blew fuse.

Took out furnace & checked resistances
— see next page. Became clear that furnace
connections were 90° out of phase, explaining
the short and the reversed thermocouple
polarities.

When moved pin, furnace OK & had
to move T/C polarities back.

Actual furnace connection (on furnace plug)



17/6/91

3	150	
4	245 → 253	
5	385	
6	503	
7	584	
8	522	
9	628	
10	628	
11	627	
12	628	
13	630	626
14	625	622 → 622
15		603
16		561
17		505
18		443
19		337
20		227
21		132
22		90
23		70
24		56

Settings 950
 200
 1000.

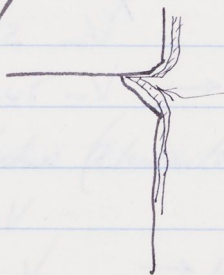
9
Amps 52
11
V 11
14

255W
 0.41W/K.

(4) = 500 (5) 355 (6) 384

On going up, spray
 a leak at ~ 950°C on
 spec. T/C. — had
 forgotten to attach
 bak tubes 1 & 2.

Leak was a junction
 of PSZ & Al₂O₃ pistons
 at top, due to
 different chamfers



Some items for future

Blank top piston

Socket & wires for testing ILC

25 pin D socket & wires "

Dimension protective plug on ILC better & provide extra cap.

ILC attach⁺ stem to be 10 O.D.

Provide some 10φ Al_2O_3 endpieces

Extension parts

Extra bottom piston

Voltage output from ILC:

Measured across pins 14, 15 with 5V excitation from Inston.

Load on ELC	0 kN	78 mV output (zero)
	2.6	175
	5.0	375
	10.0	803

readings steady.

ie $1450 \text{ mV/V full scale}$ $\frac{(803-78) \times 10}{5}$

Turned gain 1 turn anticlockwise on preamp.

Now zero = 72 mV

5 kN = 245 mV $\rightarrow 692 \text{ mV/V}$

Turned gain another 1 turn anticlockwise (2 turns total)

zero = 69 mV

A = 123 mV 5 kN = 187 mV $\rightarrow 472 \text{ mV/V}$

Put 220 Ω resistor into pin 4, 5 circuit.

zero = 64 mV (OK?)

5 kN = 187 mV

Inston now identifies it as an Inston transducer but still will not scale.

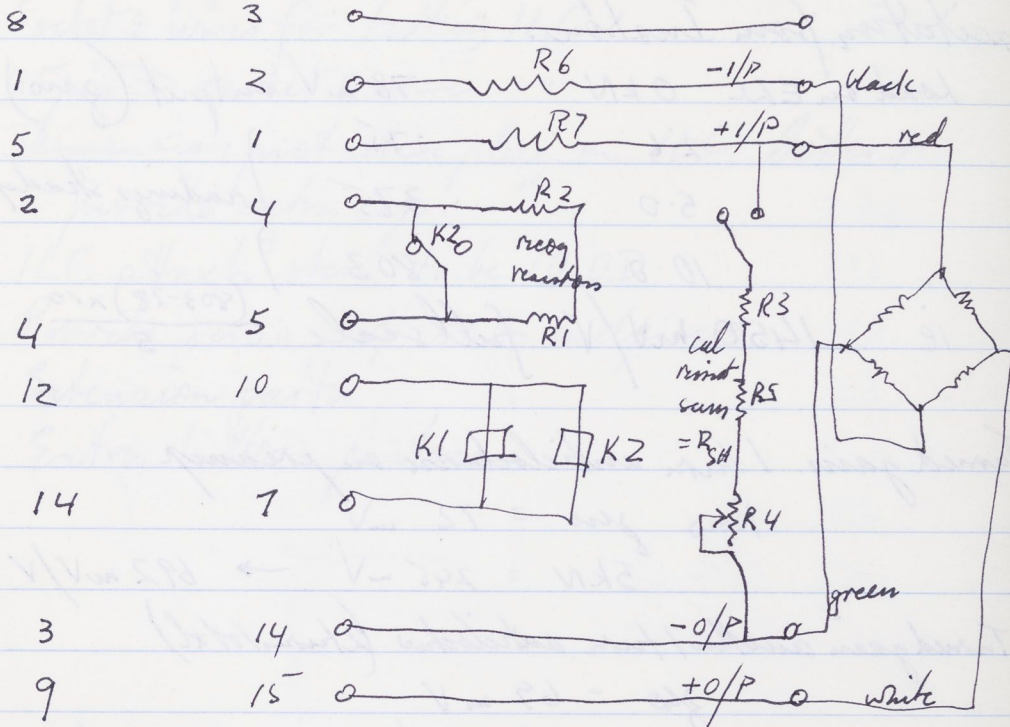
By this stage, had thrown switch on back of frame interface box from $\times 20$ ~~to~~ $\times 1$ in the extensometer channel in use.

Inston circuits :

PIN
connections

LOAD

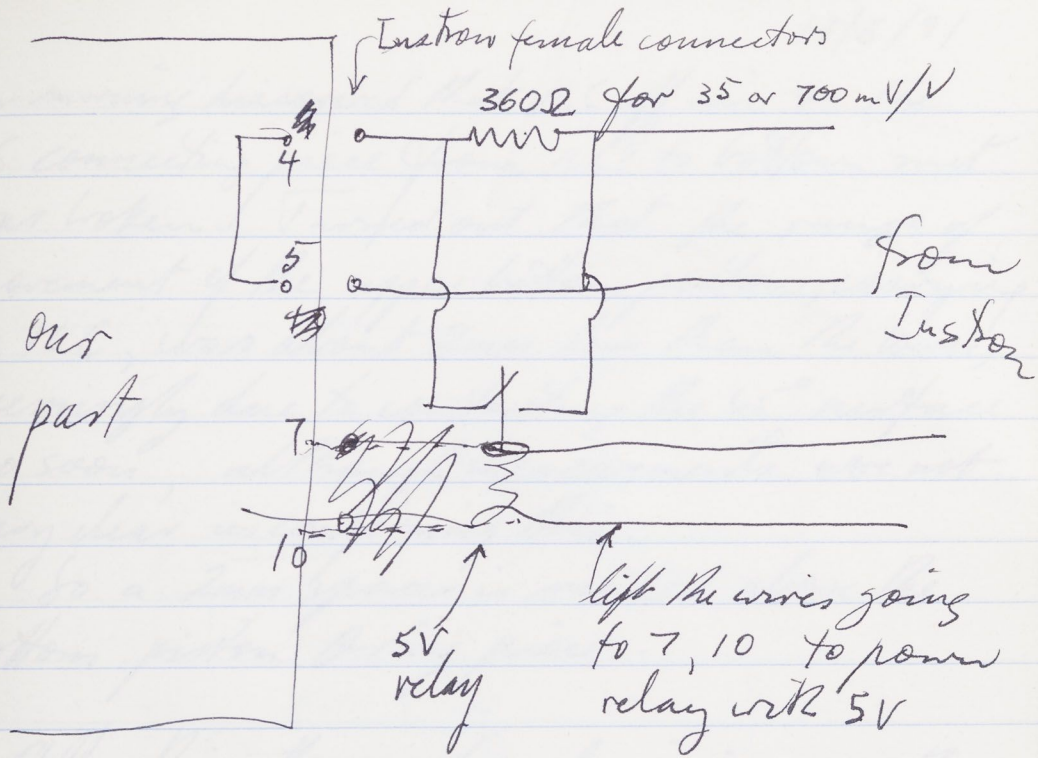
EXTENS



in box behind
connector

↑
15 pin
connector

↑
25 pin
connector

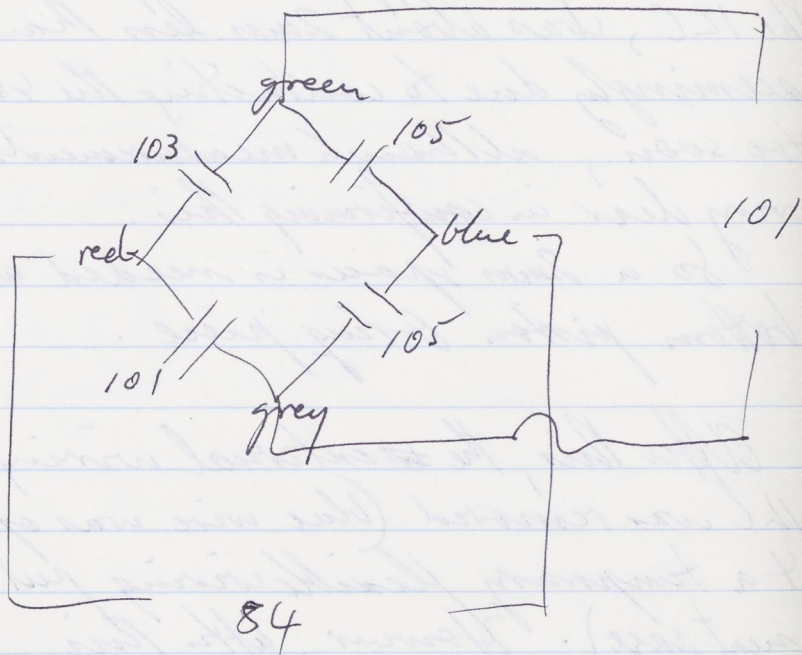


18/6/91

In morning discovered that ILC off air & the SS connecting piece from ILC to bottom nut was broken. Turned out that the range of movement of the upper bottom piston, carrying the ILC, was about 2mm less than the lower, seemingly due to contacting the 45° surface too soon, although measurements were not very clear in confirming this.

So a 2mm spacer is needed above the bottom piston O-ring piece.

After this, the ~~to~~ external wiring on the ILC was removed (blue wire was open circuit) & a temporary flexible wiring put on (see next page). However, after this, the zero of the ILC was reading about 400mV. There were no obvious shorts & the capacitance bridge did not seem grossly out of balance. At about the stage, DLK was adding things to the 4, 5, 7, 10 pin wires on the 25D connector but these are all in a separate, transducer recognition circuit in the Instron & should not affect it.



Reconnection of 16C :

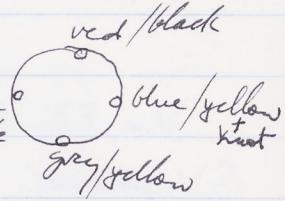
16C red $\rightarrow$ black

green $\rightarrow$ white

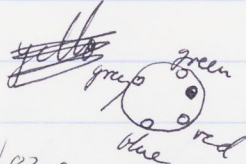
grey $\rightarrow$ yellow ^{without knot}

blue $\rightarrow$ yellow ^{with knot}

from bottom



On end of cable



red - blue 84.5 / 83.0

- grey 101.1 / 99.7

green 103.8 / 103.0

blue - grey 105.6 / 105.0

- green 105.6 / 104.9

grey - green 101.2 / 101.2

all open circuit
in resistance

* Unloaded

zero = ~~422~~ 425 mV

1 kN = 459 $\Delta = 34$

3 kN 519 94

5 kN 588 163

zero = 426

5 kN 599

zero 428

1 kN 462

3 kN 524

5kN 592

Put transformer in output line

Zero now 379 mV

On Instron side 5kN 432 $\Delta = 53 \text{ mV}$

On ~~Instron~~ ^{ILCi} side 585 } ~~206 mV~~

zero 486 } $\Delta = 99 \text{ mV}$

Reduced gain by about 6 more
Turns.

Measured on Instron side

New meter gives 227 mV at zero

5kN 279 mV 42 mV for 5kN

The Instron can shift zero; — did Prat.

" also

Told it 100 kN load cell but that load = 20 kN
when in fact it was 5 kN

Went to -10 kN — reading - 41 kN,

-7½ "

32½

61-6-249-2288

Allen 19/6/91

Power supply common should only be connected to internal shields.

Outer shield should be separated

Take a meter, resistance open circuit from pin 3 to common supply point.

Take lid off preamp, look ~~between~~ at board marked '0V' in between +12 & -12 V

"GND"

shell on plug

Could try joining them.

Transformer provides total isolation

If don't have, signal out ground point is connected to one side of Iuston - may get away with it, ~~but~~

Prefer ultimately to see it in there.

Any transformer provided input impedance $\neq 2000 \Omega$

Thinks Iuston reasonably high impedance

English one - definitely need a transformer, he thinks because of ~~single~~ shielding

If only $600 \Omega / 600 \Omega$, put $2k$ resistor in series

19/6/91

Still worried with the zero offset. So took out ILC, disconnected leads to plates & checked capacitances:

red - green 48.8

red - grey 48.5

blue - green 50.1 readjusted to 47.4

blue - grey 48.7 47.1

(had to put new battery in meter between)

After reconnecting:

taped wires closer together

red - blue 85.8

87.9

- green 103.2

105.6

grey 100.4

103.3

blue - green 106.4

107.6

- grey 106.9

109.1

green - grey 100.8

102.2

Excited, zero = 376 mV, minⁿ at 90° on diff cap
 Inston Off, " 200 mV.

CRO shows this to be 60 cycle.

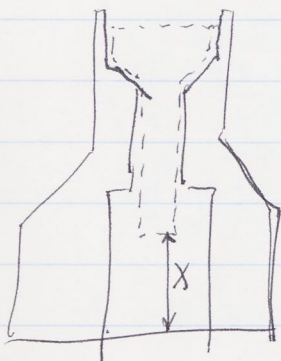
Made a new plug for Inston connection, connections as before, zero again 370 mV, down to 340 mV, diff cap at 90°; CRO shows 5 kHz.

United Transformer New York NY 0-19 4 mag shield 0-17
1#2 vs 3#4 2.5 kJZ → to preamp
5#6 vs 7#8 1 kJZ → to Instron

Calibrating Kit : Spring
Two filler pieces for spring
Threaded rods
Bottom piston with ball seat
Dummy filler pieces
Three 15¢ balls

20/6/91

When switched on power to preamp, zero = ~~22~~²³ mV before
 Instron connected
 Pressure gauges ~ 2.8 , $+0.9$ after about a minute.
 After starting Instron, zero = ~~22~~³³³ mV



According to drawings, dimension X should be 61. In actual measurement, it was 63.4 or 63 (~). The $\phi 30$ part of the piston seemed to be about 64.5 instead of 65. Thus around 0.5 of the excess may have been on the piston and nearly 2 in the body of the plug. Thus we need a spacer of 2.5, with OD 42.3_{max} and ID 30.1_{min} to prevent the fracture of the connecting rod that has already occurred. $\rightarrow$ Another measurement showed a gap of ~~2.2~~ 2.2, so 2.5 should be OK.

19-11-91

Visit to Lab - Minneapolis

Around 20 runs altogether

Done about 9 runs on HT furnace at 1300°C (2 @ 900°C)

Power fairly consistent but Temp profile varies run to run.

SS inner sleeves melted at 1200°C runs in LT furnace

MS " " " " 1300°C in HT furnace

ZrO_2 OK - but some reaction spots at hot end

they think melting is opposite join in core; it is centred around 6-9 mm above Pt mol.

Problem with some water - rusting on furnace can rather than in vessel.

Had short circuits from brass connectors to melt a couple times. Not recently. - ie plug to furnace

Once had to clean a connector in T/C circuit once

Using a type K, mineral sheathed T/C in 1300°C - dips in quickly.

ILC - Calib good to $\frac{1}{2}$ kN after 10 runs

5-50 kN external & internal agree

Pressurizing - zero goes to -3 & -4, then back to $-2\frac{1}{2}$ kN.

No obvious pressure effect

Stiffness $12\mu\text{m/kN}$ on Instron LVDT.

7.7

at collar

Friction 13-15 kN at 300 MPa.

Couple times I/C shorted out but came good again (did so on run on 20/11/91 -

Major problem is with Al_2O_3 pistons - grabbing on T/C.
Not clear which is most important: Rate-limiting

- hot pressing of the material
- plastic flow into the hole
- decarboxylation into the hole.

Possible other materials: thoriated tungsten
thoria

silicon nitride

Al_2O_3 coated SiC

CBN (stable?)

Also still a problem with buckling. (Related to iron foils ??)

Would like to have an internal displacement gauge. Linear resistor type?

Alternative to movable T/C in piston:

- captive T/C & make joints?
- rely on furnace T/C?

Problem with latter lies in non-repeatability of T profile from run to run - seems mainly to

concern the top winding - something to do with the efficacy of the Al_2O_3 paper seal? This packs down quite hard at bottom end.

Enormous swelling of top piston $\phi 30$ O-ring - some sort of "Viton". Also top jacket rings (using two small section rings) swell considerably & remain that way sitting overnight at bottle pressure. - The latter are ordinary O-rings

Dissolving jackets in aqua regia, finding as there is still some metal over specimen - takes $\frac{1}{2}$ hr or so

Instron actuator is leaking oil down the ball screw somewhere - had Instron people in.

When about to do run, found that connector to bottom winding feed thro' had overheated - seemed not to have been done up properly (probably broad stopping full tightening - should machine back first couple threads on rod) & was arcing. Cooked plastic insulators & burnt into feed thro'.

Put in a new brass connector & new insulating washer under it, & turned around the plastic liner

of the lead hole in p. oval. Also exchanged with connector mat door to avoid putting large power thru burnt feed-thru's.

[Furnace (HT) top T/C reads $\sim 1150^\circ\text{C}$ & other two $\sim 1000^\circ\text{C}$ for 1300°C specimen.
Control on bottom T/C (top T/C is too variable)]

When took out furnace, slight rust on can; that in p. was wiped off easily.

After fixing connection, furnace at BT/C = 800°C still took $12\frac{1}{2}$ amp. but now 12V instead of 24V — ie bad connection was dissipating $\sim 150\text{W}$ in previous runs. Now furnace control was oscillating until re-tuned. Tuning had not been done previously after changing from LT to HT furnace.

Controlling on B thermocouple — ~~top T/C~~

HT furnace at ~~1220~~ 1235°C & 298 MPa (10^{th} run)

Top 8.2 amp 16 V 4: 992°C

Centre 5.0 " 23 5: 885°C

Bottom 14 " 29 6: 899°C

0.53 W/K

(earlier was $\sim 0.46\text{ W/K}$)

Bit too peaky at top of profile

Using a K(Inconel) T/C & only dipping into hot zone.

Profile too peaked above ($\sim 50^{\circ}\text{C}$; Greg likes to run with $\sim 10-20^{\circ}\text{C}$ peak at top)

In first run on HT furnace, bottom current was 12 amps, now up to 14 amps on 10^{th} run; still ~~12~~¹³ amps on 5^{th} run

13.75 6th run
now 14.1 7 at 1300°C

→ went up to 15 amp early in the run while at 1300°C . But set-point still similar

When we had the furnace out, there seemed to be a join in the core at about 8 mm above the bottom end of the inner sleeve — but there shouldn't be such a join according to the drawing. Is there a crack here?

Has handling the furnace shaken the zirconia loose insulation around? It was tipped up & down many times. There is also a break in the Macro bottom piece, at the lip below the core.

Final furnace adjustment 0.55 W/K before deformⁿ. At end of run, 0.59 W/K . ~~See~~ Jacket O-rings more swelled than previously but still not affected by heat except to swell.

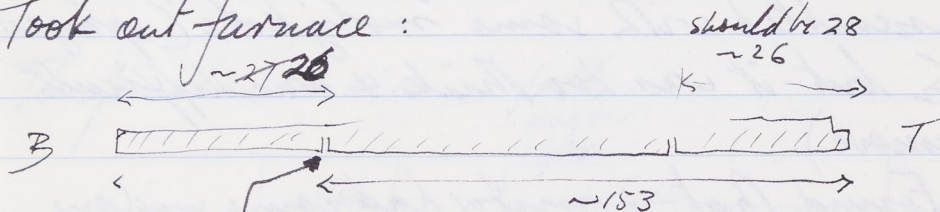
at 1300°C

New piston used in the run / shortened from 50.14 → 49.62, $\phi 14.99$ → 14.65 hot end

Spacer (fresh) $\phi 10$, originally $l = 12.22$ now 12.23
 (McDaniel 998 from a distributor) $OD = 9.98$ " $OD = 9.96$
 i.e. no change resolved.

Previously used piston didn't change much. + piston shortening
 Specimen shortening comp to observed shortening & so
 shortening in new piston must have occurred under
~~hydrostatic pressure~~ initially during deformation //
 at ~22 MPa — still could be densification with time.
 Decrease in ~~spec~~ piston diam > hole fill-in

Took out furnace:



Inserted 50 mm length of iron liner in bottom end to cover the gap (couldn't tell whether it was an intentional join or not, but it seems to be exactly at the bottom end of the bottom winding)

22/11/90 :

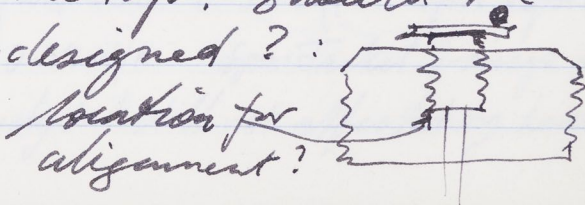
Grg worried about 30 kN offset in ILC reading, so bottom plug taken out (can do so OK without taking out furnace). Bit of dust but seemed OK.

Discussed new lead stem, possible change to half-bridge wiring so as to incorporate a displ transducer such as linear throat, etc.

Also several problems with pickup — next to ILC, & on ILC piston; comp. piston seemed to be OK. Everything very dry. Reassembled with some molykote (sprayed MoS_2 but it was too thick & was difficult to remove).

~~It~~ Found that a rivet had come undone (part of attenuator) so re-soldered — this more or less restored the zero but it was now around +1 kN instead of -2 kN.

Discussed problems of misalignment — question of squareness & rigidity of the small screw at the top. Should the top plug be re-designed? :

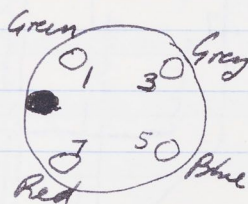


23/11/91:

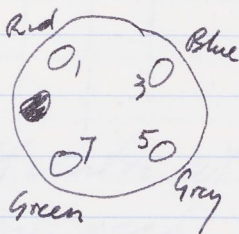
New ILC Lead

Looking from preamp to ILC

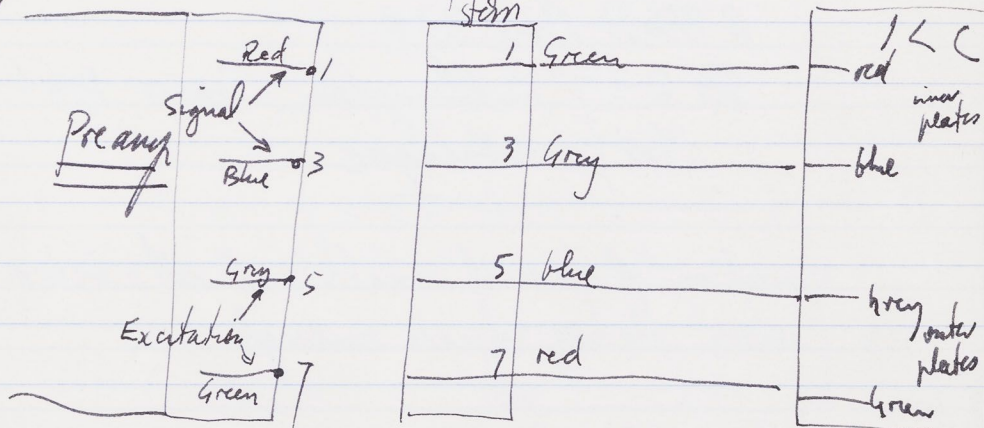
new one:



old one (which mates OK to colours in ILC):



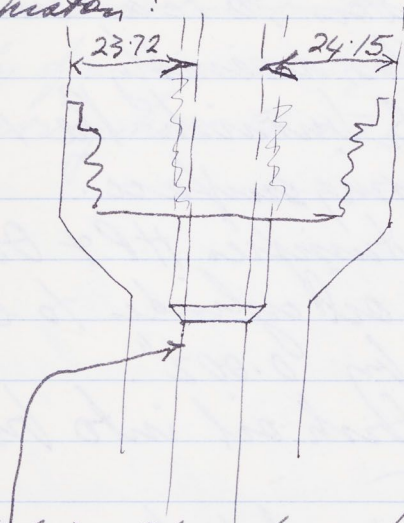
Therefore had to wire as follows:



Had to extend red wire (not) because cut off too much by mistake. Soldered up. Seems OK

Piston now would not screw on to load cell.

Checked piston:



across at approx
azimuth of flats

$$\begin{array}{r} 24.15 \\ 23.72 \\ \hline 0.43 \\ 0.215 \\ \text{off centre} \end{array}$$

So this hole is off centre at this end by 0.215;
not bad at bottom end, so presumably drilled
from that end.

29/11/91

Discussion with DLK:

1. EDM ILC piston to reassemble
lower piston assembly

Possibly MoS_2 burnish the ILC
piston bearing surface.

Ditto for intermixer HP & Oil pistons.
Could hone oil cylinder to ease
oil piston by "0.002".

How to put fresh oil into bubbles

Dave to explore internal displacement gauge.
(Steve M has tried Trans-Tek LVDTS,
OK in pressure vessel)

Trans-Tek

Ph: (203) 872-8351

P O Box 338

Rt 83, Ellington Conn 06029

Not in catalogue

Question of face of small nut retaining the
top piston being square enough.

Left 8 Al_2O_3 pistons + 2 PSZ pistons.

Dave to send order for 6 pistons + 2 PSZ pistons
+ new furnace.

Next April:

Dave keen to have me visit

Possibility of a seminar to pay a little.

Leave Spring here & me collect it in April

19/7/92

Furnace 006

Returned for refurbishing this week, after runs at 400 & 500 MPa 1300°C (total 23 runs).

Insulation, with SAI inner insulation, in good condition.

presumably Bendigo core
Al₂O₃ furnace core cracked at bottom of bottom winding & ~ 1/2 way along it; & the piece in between had an open longitudinal split (did this open up in 500 MPa run?).

PSZ upper core also had a longitudinal crack.

Asked Frank to make grooves shallower (~0.6 mm) in new core, as well as introducing 45° chamfer at ends of grooving & larger radii at bottom of grooves (the core in above case did not yet have this mod.).

Top winding still bright, & wires more brittle.

New Macor part needed at bottom & top-most.

Crack in middle of bottom winding looks older, & at bottom looks fresh. Longitudinal crack looks old & there are a few more small ones

28/7/92

Furnace 006 - refurbished

Resistances

{ Top winding	0.006 (7)	—	0.003	= 0.003 ^{0.3}
{ Centre "	0.001 1.1	"	"	0.008 ^{0.8}
{ Bottom	0.006	"	"	0.008 ^{0.3}
Top T/C	0.9	—	0.3	0.6
Centre "	1.0	—	0.3	0.7
Bottom "	1.2	—	0.3	0.9

New Macor at top (no 11) & bottom (no. 21)

New Alumina core Duranite from Graeme,

New upper core (PSZ)

New wire from Degussa.

Cleaned silver contacts (by dipping in Goldard silver dip, rinse)

Zirconia paper against core; same SAH1 insulation as before; alumina paper elsewhere

Furnace ⁰⁰⁷ ~~005~~

8/8/92

- returned, never useful from first assembly.

Before disassembly, could see:

- small longitudinal crack in PSZ at hot end
- large circum crack low in Al_2O_3 - wide open
- " " " high in Al_2O_3 - fairly open.
- some longit. cracks low in Al_2O_3
- another circum crack somewhere in middle of Al_2O_3 .
- a number of meandering cracks high in Al_2O_3

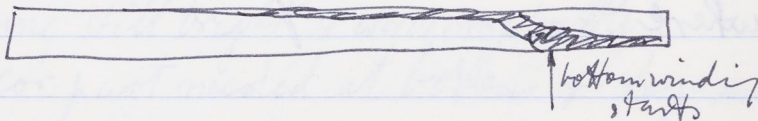
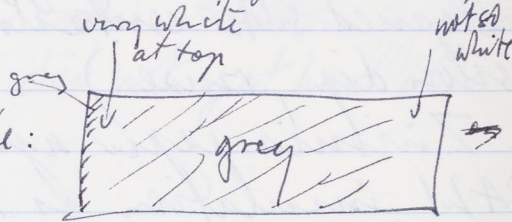
Opening up: ~~First segment~~

Some discoloration at bottom end of outside Al_2O_3 paper
1st segment
Lot of color on bottom face & $\frac{1}{2}$ way up dia of lowest PSZ piece at hot top.

ASH piece OK.

SALI discolored on outside:

Bundling
core



Other segments similar; slight asymmetry in temp contours.

Core: Cracks - bottom of bottom winding } both cracked
- top of top winding } off & fell apart
- bottom longit crack runs up to bottom of centre winding

Longit. crack in PSZ piece as in last furnace.

^{Crack}
Crack at bottom of bottom ~~winding~~ winding fairly
disrupted - open during running

Crack at top of top winding clean but at
higher T than C contour.

Again longit streaks in the alumina - higher
density, let light through

At top winding, core ID = 20.85, 20.75 out of round
cold bottom = 21.00 .01

At top join = 21.00 .01
just above top crack 20.9, 20.8

Join in PSZ & Al_2O_3 could be further up?

11/8/92

Rebuilt by Frank with new Duramic core, all other
parts the same - using alumina paper. Checked
connections (leads 0.3)

Top	Winding	0.7	T/C	0.9
Centre		1.2		1.0
Bottom		0.9		1.3

Oct 92

Sent back for checking lead connections
— were loose on core.

Refurbish no 6:

now segmented core

26/10/92

Cut off bottom of bottom winding, & added lower end with overlap

Resistances (0.4 zero)	TF 0.7	TTC 0.9
	M 1.2	M 1.1
	B 0.8	B 1.3

Winding grooves still 0.6 deep.

Lead connections now loose.

13/2/92

No 6: Back for refurbishing. Frank's description on telephone:

- added piece appears pushed down a bit.
- some "corrosion", brownish, on winding - "contamin"?
- alumina paper hard
- one section of SAH at top cracked through; some other partial cracking.
- core added piece has lip cracked off (not Bendigo material: is yellowish)
- winding ties were still loose.

Refurbished with new lower core extension machined from Bendigo stock, otherwise all parts as before.

Resistances (0.4 zero)	TF ^{0.7} 0.6	TTC 0.8
- 0.3	M 1.2 1.1	M 1.0
	B 0.6	B 1.2

except bottom winding

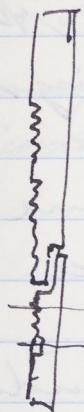
Furnace 002

26/2/93

Early LT furnace with SS upper core.

SS core was very loose,
insulation missing — they
must have removed this.

confirmed by them



cracked midway in
lower winding

cracked at bottom
of lower winding

Bottom TAC segments all cracked.

Some connector screws loose & some
rotated — must have been fiddled with.

Bottom T/C damaged near top — needs
to be replaced or welded.

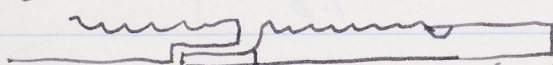
Connectors very black — been very hot?

Insulation OK — rather grey next to
windings

Furnace 006

13/2/93

Some gunk on winding; SAG1 cracked through



↑ cracked off here on bottom
section of articulated core. Also some longit.
cracks in the thin broken-off part (not Bendigo
material). Put in a new part & sent back.

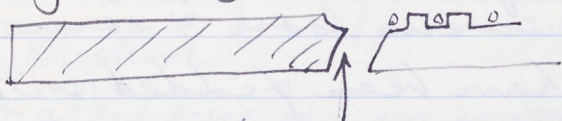
Furnace 007.

5/3/93

This had been re-assembled at Minneapolis using a tougher insulation paper. Also they had put cement over the windings. Fair bit of carbon around.

Insulation generally OK but some crazing of SAI at hottest place. Connectors a bit loose

Bottom of core, just below bottom winding, very neatly cracked.



There was also one short longitudinal crack running back from this crack face.

1/4/93

Refurbished with same insulation & parts but new Coors core. Old PSZ ^{upper} ~~upper~~ core

Resistances: Windings T/C

0.6 0.8

1.2 1.0

0.6 1.2

15/4/93

Cracked first run before 1100°C. Ramped 20°C/min, ~100 MPa, settings 40/30/100 (usual)

Runrun 002 (LT)

1/4/93

New Coors core

(returned 26-2-93)
to us

New PSZ ~~was~~ upper core.

Same parts otherwise (bottom Macor cracked)

Resistances: Windings T/C

0.7 0.7

1.2 0.8

0.7 0.9

15/4/93

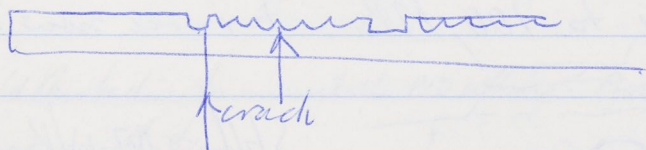
Initially bottom winding attach^t screw was loose -
They had to tighten it. } Took OK when I checked it
Core looks OK. } Also bottom T/C shorted.

Bottom T/C giving low readings - shorting near top.

On heating, hot near top & couldn't get above 800°C

Couldn't control on bottom

8.8	50%
6.1	70%
14.2 A	100%



? which is
thin? 007?

Test run over page.

15/4/93

Furnace 006

Its efficiency improved as temp went up, from 0.52 down to 0.45 W/K.

2nd calib, 18 runs up to 1250°C - 1100°C

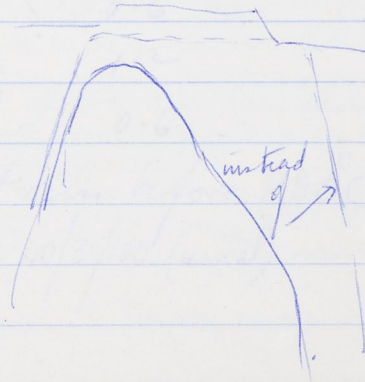
On 19th run, calib 3 pressures. Then power failure, cooled, switched on, full power back (without ramping up). So could have been thermal shock.

Did a deformation run after but furnace not stable
~~002~~ 10° ^{run while I was there on furnace 002 (27)°} ΔT across specimen at -600°C
 cooler downward no 4: 552°C controlling

Currents:	4	8 amp	10V: 80	5: 398°C
	5	14 "	11 44	6: <u>not connected.</u>
	6	16 14	22 <u>358</u>	at ~700°C
			<u>487</u>	0.7 W/K.

Getting worse at 700°C. Pressure 130 MPa.
 Dropped pressure to 100 MPa. Furnace now more responsive

T_{profile}



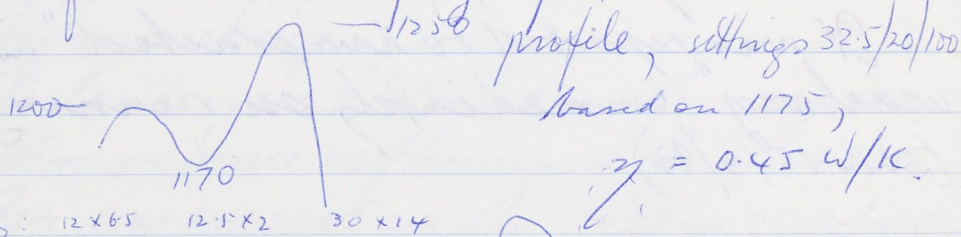
Still ~0.7 W/K.

802
Dropped pressure further to 90 MPa, immediately
more responsive but gradient still bad.

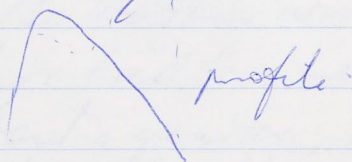
With only bottom winding, peaks below specimen
at ~~$\sim 1025^\circ\text{C}$~~ $1050^\circ\text{C} \rightarrow 1080^\circ\text{C}$ still climbing.
Controlling at 800°C on no. 4; 94 MPa.

Now brought in no. 3 & 4 windings at half previous
rate, drops lower temp rapidly (still controlling
on 4) - temp distrib now flatter but rather
unstable.

Temp up to $\sim 1250^\circ\text{C}$ but very unstable - must
be a gap above hot zone, or PID settings are off for
control of bottom winding by top T/C.



Slight rise in 3 & 4 powers gave



Could this be due to unmountable PID setting? Probably not - should just
give an oscillation

Took out next morning - cracks in core about $\frac{2}{3}$ way up
bottom winding (38 from bottom end of core).

30/6/93.

Recent histories:

002

After the run described on previous page, the furnace was returned to Canberra (~27/4/93). It was fitted with a new Coors core with a longer bottom winding & shorter centre winding ~~4~~, and a new fully ASH insulation (the previous composite insulation had shrunk somewhat & the bottom T/C shorted to the winding). Sent to Minneapolis 30/4/93.

It was reported to have cracked "in the usual way" immediately on running.
(Duke 15/6/93)

twisting the wires together??

Altogether, these observations fit with extreme thermal shock as described 2 pages back.

906

After the history reported 3 pages back, I am not clear whether the furnace had more usage or not.

It was returned to Canberra recently ($\sim 25/6/93$).
A postmortem showed:

1) The core was extensively cracked up & had expanded in diameter nearly 1 mm about one-third to one-half the way up the bottom winding section, opposite the place where the iron sleeve had begun melting.

2) The lands were distorted in this region, indicating extreme softening of the alumina.

3) There was one spot on the bottom winding, about $\frac{2}{3}$ the way up, where there had been melting, & the section reduced to about a quarter; below this spot there was superficial melting of the alumina.

4) The bottom separate section  was cracked around at the ~~ex~~change in section.

5) The bottom end of the centre winding had broken off  with indication of melting as shown — may have been cracked originally in
TOPRO

001

This furnace was dismantled in Minneapolis & I took the core to show Coors → now lost in my lost suitcase. It had cracked in "the usual way" in the first heating cycle. The remainder had been sent back to Cambrea at the same time as 002 and fitted with a Burdigo core, made with longer bottom winding & shorter ~~top~~ centre winding, and new fully A5H insulation. Returned to Minneapolis 30/4/93. It was reported "not to have broken" (DLK 18/6/93) & presumably has continued in use, changing the input taps on the transformer so as to get sufficient volts for the longer bottom winding — now can get to 1300°C , using less current than with the shorter bottom winding ("based on a single run").

Returned to us 7/7/93 $\frac{1}{2}$.

6/8/93

007

Coors core ground out to $\phi 22$, standard length 150 (had to shorten 1.12 from Coors over-length)

Titanium sleeve 21 ID, 22 OD fitted full length to core. Sliding fit.

New ASTH insulation

Old T/C's rehabilitated

All other parts the same (bit chipped at bottom)

Top T/C	^{3100.4} 0.9	Top winding	0.6
Centre T/C	1.1	Centre winding	1.2
Bottom	1.2	Bottom winding	0.7
		³¹⁰⁰ 0.4	

9/12/93

006 With double walled Coors core & new non-split Marcor "top" piece 3105-14. New ASTH insulation

Old T/C's & other parts

Top T/C	^{3100.6} 1.0	Top winding	0.8	0.7
Centre	" 1.2	Centre	"	1.3
Bottom	" 1.3	Bottom	"	0.8

1LC:

8/94

Pressure effect is $\sim 3.5 \text{ MPa}$ ~~per~~ at 300 MPa confining pressure.

Furnace 006 - Returned % T/C chart to winding

Before dismantling: (300 0.0)

T/C	Top 0.5	Windings	0.3
	Centre 0.6		0.7
	Bottom 1.5, 1.7		0.3

On dismantling:

Centre T/C had end of Alumina sheath broken off, & lead open circuited.

~~Alumina paper inside still in this furnace.~~ No.

Core broken (inner & outer) at bottom of bottom winding & at top of top winding.

[Wings in Potodan 009 were all cooked]

Bottom T/C also had the alumina apparently corroded & some bright speck & cord on the windings part of core.



SAH segments appear to have twisted, or at least two of them have!

~~Potsdam~~
[009 has aluminum paper pad under T/C]
[011 does not]

14/11/94

Furnace 006 refurbished
3 New T/C's, modified design, shorter by
 $\frac{1}{2}$ mm

New top winding

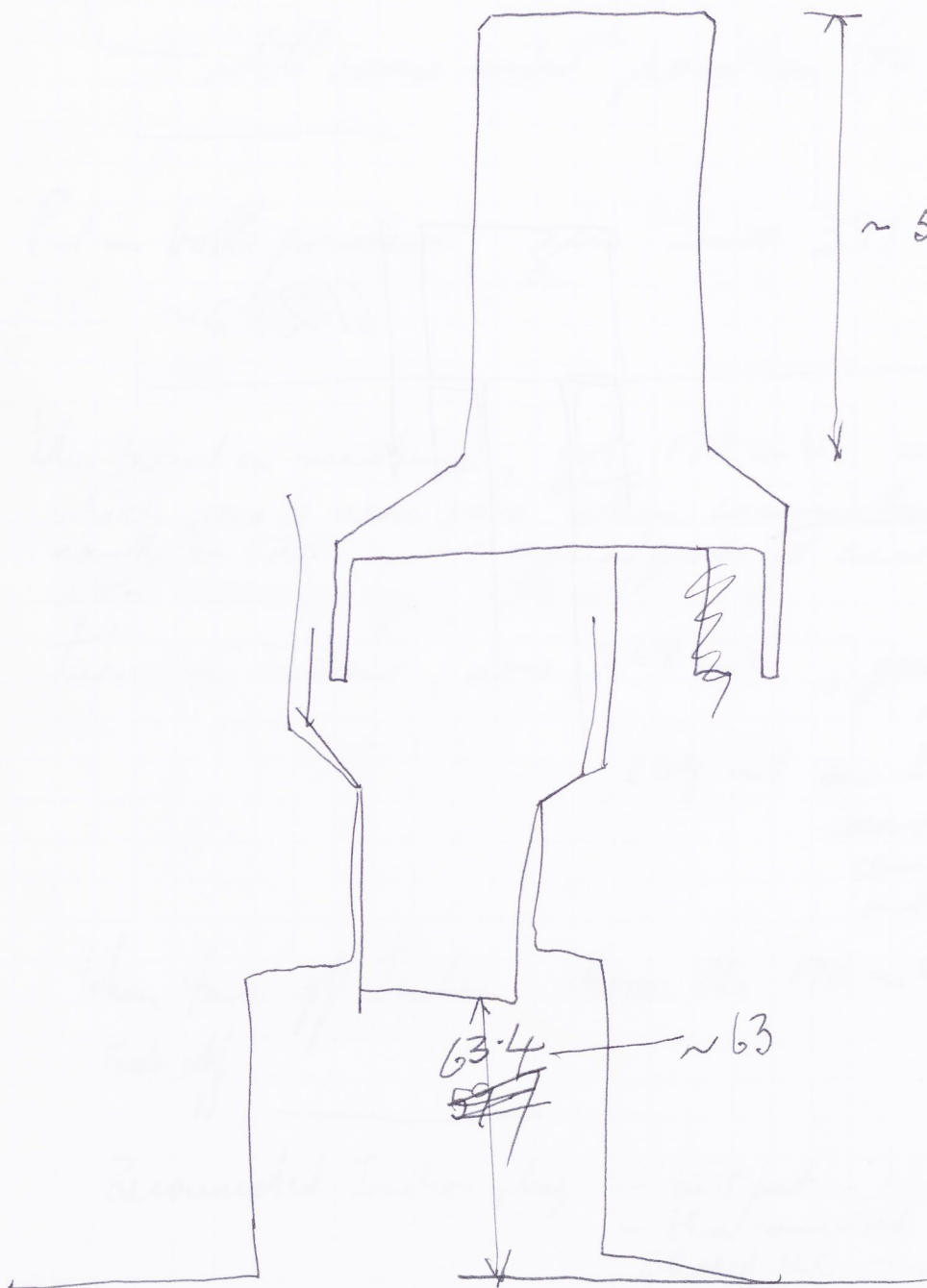
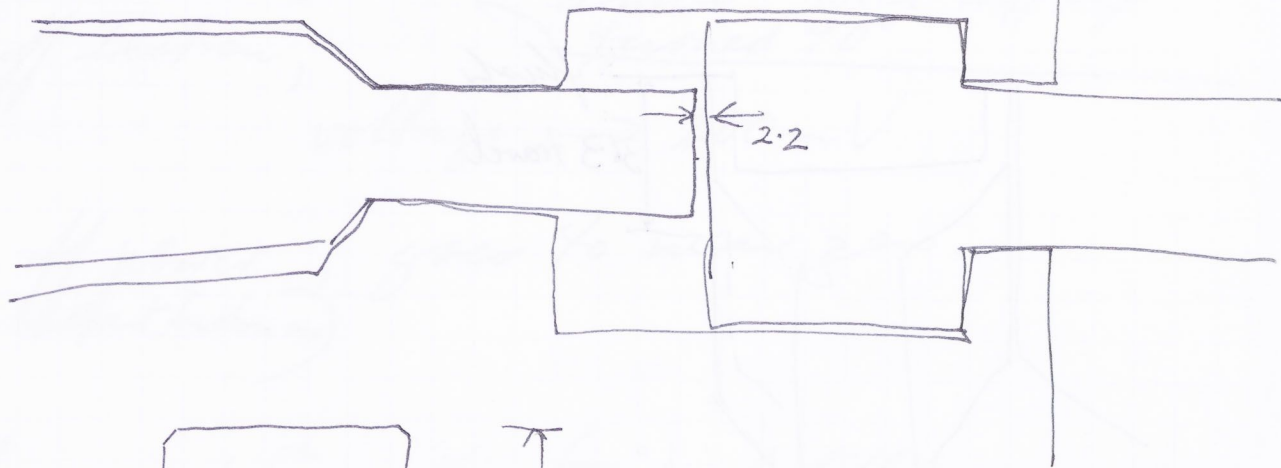
New SAIL

Macor broken, up to 5 pieces in one segment.

Resistance (zero 0.2):

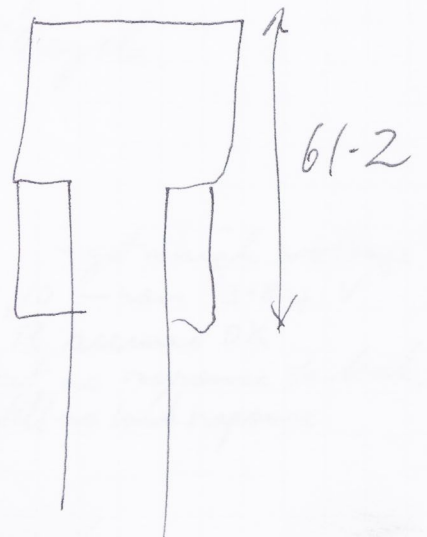
T/C	0.6	winding	0.5
	0.7		1.0
	0.8		0.5

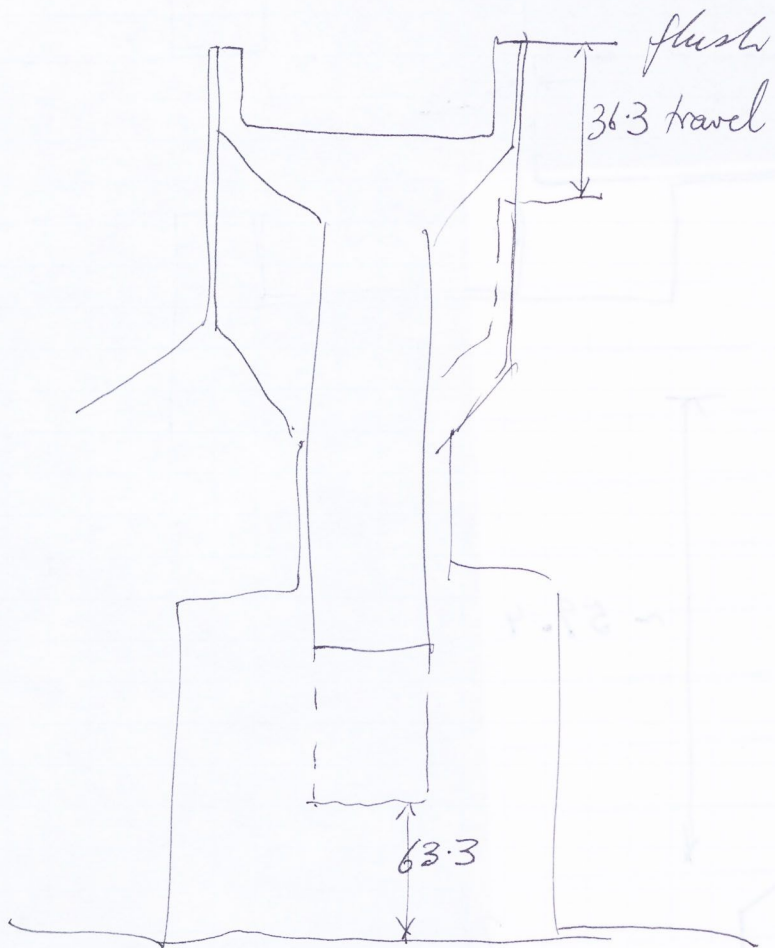
THE REMAINING PAGES
IN THIS NOTEBOOK
ARE BLANK



~ 59.4 ?

$$\begin{array}{r} 71.4 \\ 3.0 \\ \hline 68.4 \end{array}$$





19-6-91

With Instron on, zero = 376 mV, more or less at
a min^m with diff cap
turned 90°
If turn off Instron,
voltage → 200 mV

If turn off power
(with a locked Instron on) goes to near zero.

still same min^m position (90°) of diff. cap.

Put in bottle pressure, zero → 391 mV
~ 6 MPa.

PM evening:

When turned on machine, got 172 mV without Instron on,
which goes to near zero when connected to CRO, or connect
earth to CRO. ie signal goes if earth one side
After warming up, 176 mV.

Turned on Instron, now 368 mV, goes up if earth one side } on machine
down other side

264 mV on Instron side, unaffected by
earth on either side, unless
connected to CRO when it takes
out signal if live is earthed.

When turn off Instron, ~~have~~ the 170 mV is 60 cycle.
Took off

Reconnected Instron plug - first put in 1, 2, 3, 14, 15 - got a high voltage
- then connected 4, 5, 7, 10 - now 3.84 V
Checked ILC - cap & R seemed OK
- then had 134 mV but no response to load.

moved diff cap to centre pos → 75 mV but still no load response

switched off Instron → 138 mV

power off ILC amplif → 29 mV

Plugged in Pump again, now zero 370 mV, → 340 mV.

Turned off Instron, have ~ 26 mV.

→ CRO loads down to ~ 300 mV,
reasonably clear 5 kHz.

Taking off ~~the~~ voltmeter leads gave no change in Instron reading

Red - green

48.8

Red - grey

48.5

Blue - green

50.1

Blue - grey

48.7

cap off	cap on	rezeroed	rezeroed by clamp on paper	cap off
46.8	48.8	48.0	43.4	43.1
49.9	49.9	47.1	41.4	42.0

blue - green

47.6

46.9

47.1

47.1

put cap on

49.4

off

49.2

on

49.4

off

47.7

on

47.6

47.4

blue - grey

46.2

47.2

47.1

47.0

50.0

49.6

49.9

47.5

47.0

47.1

taped loose leads together

Red-blue

~~103.2~~ 85.8

87.9

-green

103.2

105.6

-grey

100.4

103.3

blue - green

106.4

107.6

-grey

106.9

109.1

Green - grey

100.8

102.1

