DATE: March 24, 1997

TO: File NR-8078-D-801-S (Formerly NR-531-D-101-S).

FROM: Eric Compton, Engineering Co-op NMSS/IMNS/IMAB E.C.

SUBJECT: Inactive Status of TLD Irradiator

In a telephone conversation with David Katzman of the Panasonic Company on February 10, 1997, he stated that the company had not sold the product since mid 80's. In the interim several companies have had distribution of the WE 2001 Series TLD Irradiator. However, since the device may be drop-shipped to the DOE or its prime contractors without the issuance of a formal certificate of registration under 10 CFR Parts 40 and 50, Performance Data Company, in Florida, is currently distributing these devices and is pending for a device registration certificate through the state of Florida. Therefore, since the Panasonic Company no longer sells, markets, or possesses the device registration certificate NR-531-D-101-S was changed to NR-8078-D-801-S.

February 10, 1997

Panasonic Industrial Compnay
(201) 348-5500 5339
David Katzman

Spoke to David Katzman about making NR-531-101-S inactive. He stated that the Panasonic company hasn't sold the product since 1985, and they no longer provide services. Services are provided by a firm in South Africa and Performance Data Co.

Contact:
Bill Vaughn
Performace Data Co. -- <Florida>
(305) 232-0504

Phone Log: Performance Data

3/6/97 left telephone essage
3/7 received telephone message
3/12 left telephone message
3/14 Conversation w/ Bill Vaughn

Two other companies have distributed the WE 2001 Irradiator, after Panasonic discontinued (1987). Performance Data Co, has been distributing and providing services (with exception to sealed sources, handled by customer through Amersham) for the Irradiator since 1993.
Performance Data currently is pending for a registration certificate through Florida. Application was summitted in 1995 and Fees collected.

THE NEW GENERATION
TLD IRRADIATOR
WE 2001 PC

WE WILLISTON ELIN

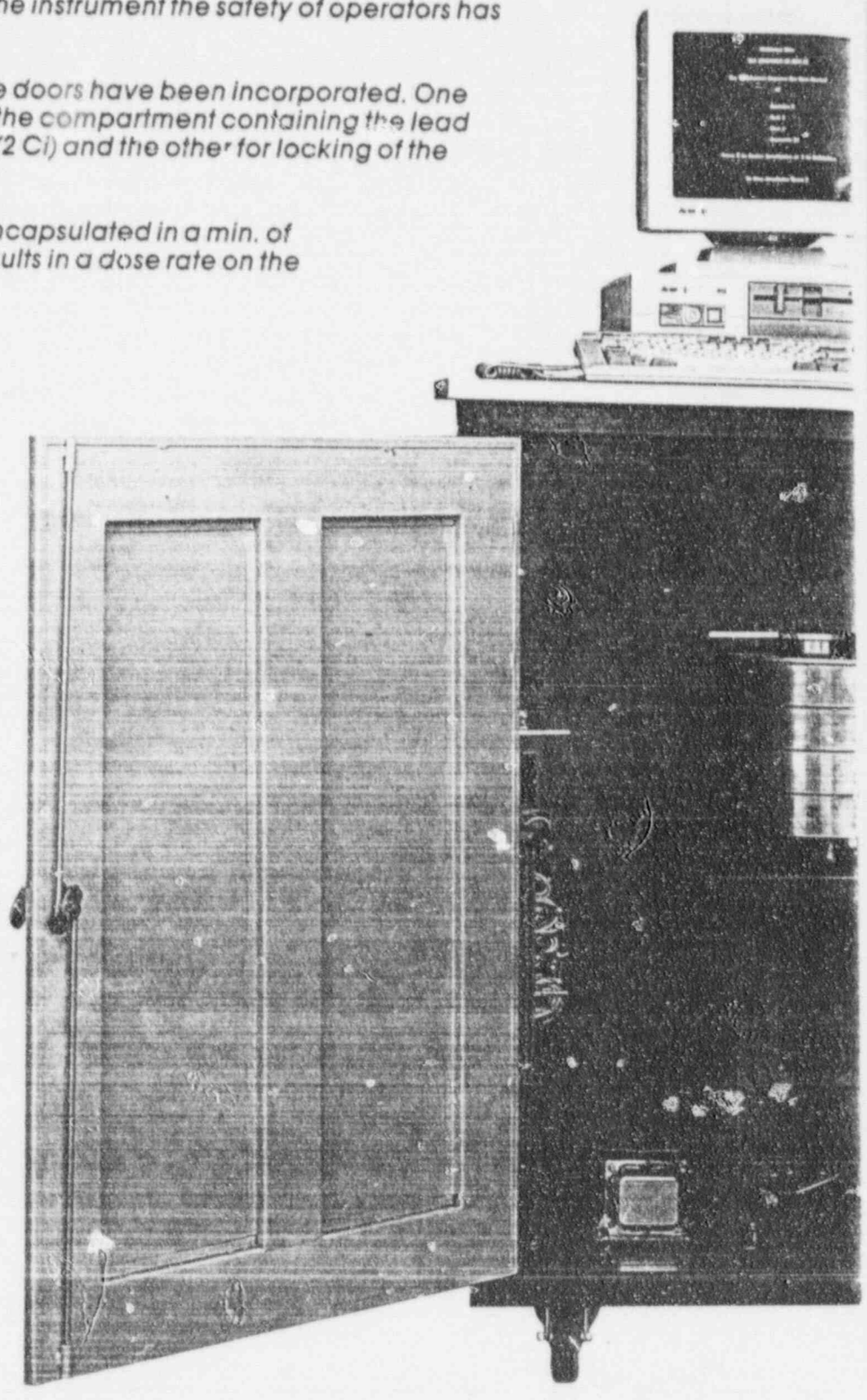
GENERAL

The WE 2001 PC TLD Irradiator has been designed to give the user greater flexibility, as it is controlled by a Personal Computer.

The WE 2001 PC Irradiator is designed to irradiate 500 dosimeters in 10 racks irradiating each dosimeter sequentially. This process is fully automated. In designing the instrument the safety of operators has been given top priority.

Two independent lockable doors have been incorporated. One door to prevent access to the compartment containing the lead castle with CS 137 source, (2 Ci) and the other for locking of the magazine compartment.

At all times the source is encapsulated in a min. of 100mm of lead, which results in a dose rate on the surface of the steel cabinet, top and sides of ≦ 0,2mR/h, at the bottom ≦ 0,4mR/h, at this low radiation level no special radiation protection room is required.



SOFTWARE

A Menu Type Software has been written in such a way as to make it extremely user friendly; eg:

— In the event of a power failure the position of the last dosimeter irradiated is remembered by the computer. This allows the user to carry on where the irradiation cycle was interrupted.

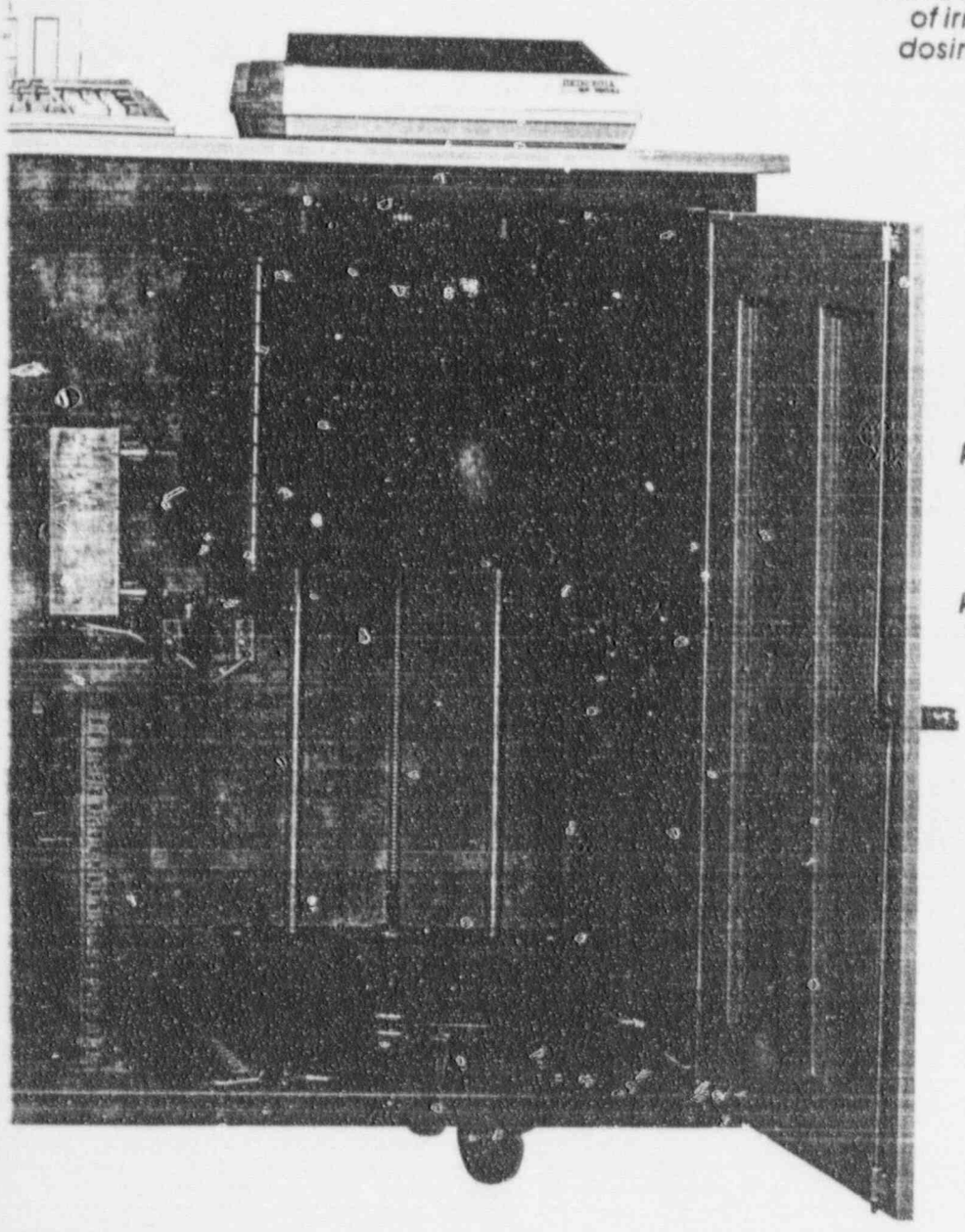
— The Software allows the user to enter different irradiation times (ranging from 1 second to 9999,9 seconds in 0,1 second increments), for dosimeters in the various racks and slots. These times are stored on disk in case of power failure.

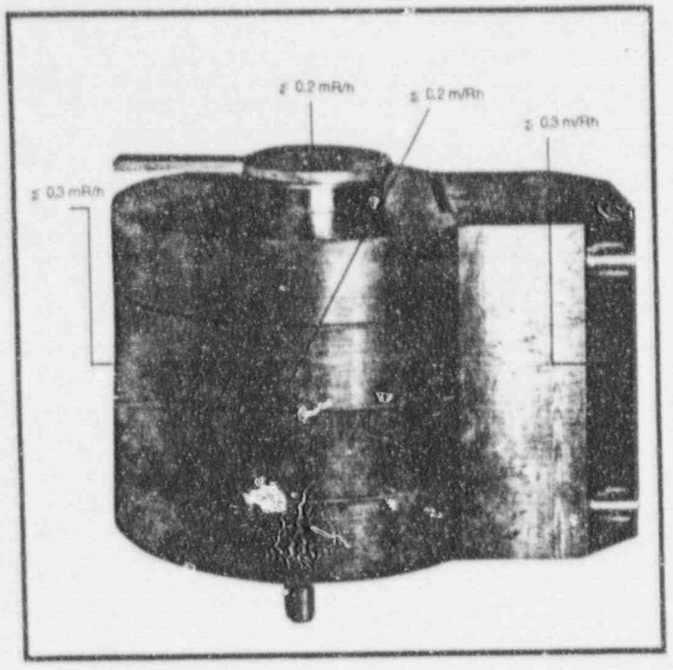
— The date and time of day can be entered and a printout of irradiation times for each dosimeter can be printed on an optional printer.

— The screen is constantly updated to display the dosimeter slot number and rack number of the dosimeter being irradiated.

— All failures of light sensors, limit switches, power supplies, stepper motors, etc. are displayed as an error message on the computer screen, keeping the cost of fault finding to a minimum.

The computer is not dedicated to control the irradiator and can act as an extra computer in a department while the irradiator is not in use.





LEAD CASTLE

The dose rates as measured on the lead surface are as indicated.

The lead castle incorporates a removable filter in which perspex and lead sheets can be mounted.

The perspex is used to minimise the effect of over response due to electrons.

The 2 Ci source is located at a short distance from the dosimeter which results in an exposure rate of approx. 37mR/sec.

Sources with lower activity are also available.

OTHER WE PRODUCTS

TLD Packaging Machines
TLD Cleaning Machines
Automated Sample Changers

WILLISTON ELIN

TLD IRRADIATOR

WE 2001 SERIES

OPERATING AND SERVICE MANUAL

THEORY OF OPERATION

The WE 2001 TLD Irradiator is designed to accommodate 10 magazines of 50 dosimeters each (ie 500 dosimeters).

The magazines do not have to be fully loaded with dosimeters and also do not necessarily be loaded in consecutive rack positions.

On pressing the start button on the electronic consule the rack motor will drive the rack to the position of the first magazine found in the rack. The feed motor will then feed the magazine through to the lead castle containing the Cs 137 irradiation source.

The dosimeter arm will lift the first dosimeter out of the magazine and place it in front of the source for irradiation. The time of irradiation is preset by the timer in the electronics console.
After the preset period the dosimeter is replaced in the magazine and the next dosimeter is found. This process is continued until all dosimeters in one magazine have been irradiated. The magazine is then returned to the rack and the next magazine continues the process until all racks loaded have been completed.

At the end of the cycle an intermittent alarm is given to advise the operator.

Indicators

The electronics console has two LCD displays marked rack and dosimeter.

a) Rack

This indicates which rack number containing a magazine is being irradiated.

b) Dosimeter

This indicates which dosimeter in the magazine being irradiated

Interlock

a) There is an electronic interlock in the instrument which prevents operation of the instrument under any alarm condition.

Timer

The timer which is located on the right hand side of the top rack can be set for preset irradiation times by means of the thumbwheel switches from 0,1 s to 9990 hrs.

OPERATION

LOADING

a) Open door on rack in order to laod magazines
b) Load magazines which are numbered 1-50 with 1 closest to lead castle (ie. the gear teeth on magazine towards the back of the instrument).
c) After laoding make sure that the rack door is closed again to ensure correct operation of the instrument.

ALARMS

There are four continuous alarms indicating faults and one intermittent alarm indicating completion. All alarms can be silenced by pressing the "stop" button on the electronic consule.
Note; If the "stop" button is not pressed the machine will not start.

Type of alarms:
a) "Source position"

This alarm will occur if the "start" button is pressed to commence irradiation and the source is not in the correct position for irradiation and the LED will light.
Turn handle until it presses against the limit switch on the lead castle and the LED on the electronic console will turn off. The alarm can be silenced by pressing the "stop" button.

b) " Rack Fault"

This alarm indicates that the door on the rack has not been closed properly. Press the "stop" button to silence the alarm and close the door to turn off the L.E.D.

c) "Double mag zine"

This alarm indicates that a magazine has been doubly loaded into the instrument One will be under the lead castle and the place in the rack for it to return to will have also been loaded with a magazine. Press the "stop" button to silence the alarm and remove the magazine to turn the L.E.D. off

d) "Power Failure"

This L.E.D. will light and the alarm will sound, if a power failure occured during the irradiation of dosimeters. One should look to see which magazines have been completed and these should be removed from the unit. On pressing the stop button the machine will return the magazine of dosimeters being irradiated to the rack and the rack will move to the fully up position. On pressing the "start" button irradiation of the rest of the magazines will commence.

e) On completion of a full cycle a 1 second intermittent alarm will sound to make the operator aware of this.

f) If, as dosimeter gets stuck on leaving or being returned to the dosimeter magazine a time out will occur. The same will occur if a rack cannot be fed by the DC motor in under the lead castle or be returned to the rack. This alarm is a 0,1 sec. intermittent alarm, which turns off all motors and can be reset by pressing the "stop" button. This also resets the machine to start position. All magazines that have been irradiated must be removed to avoid double irradiati

ASSEMBLY OF LEAD CASTLE AND LOADING OF SOURCE

1. Remove the aluminium plate separating the lead castle from the rack. Note; Leave square tubing cross bar and angle brackets so as not to have to set light barrier after loading of lead.

2. Locate no. 5 on the lead castle assembly drawing, (groves machined at base of lead To load, move block carefully forward towards the dosimeter push-up assembly (aluminium bridge no 19 containing brass moveable push-up rod) until it just seats. Note; For easy loading use handles supplied in spares box. Push bolts through to h in lead block.

3. Locate lead block no. 4 (block has groves machined at lower end). Move this block gently into position with flat end towards dosimeter push-up assembly 19. Screw the two lower 8mm bolts with steel spacer 18 into lower lead ring at this stage.Load block 3,2 and 1 sequentially in the same manner. Screw 1 to lead block with 8mm bolts supplied.

4. Locate sleeve 8.Leave whole assembly mounted as is. Remove nylon stop and turn han so that source holding screw is visable. Remove 1 m loading rod 21 from frame of instrument located on the inside of left hand door. Remove hook 22 mounted on cros bar of frame in main machine and screw to handle 13 by removing one of the handle retaining screws.

5. Place sleeve 8 into hole in lead castle 6 and place a spacer (eg. wooden block) under it so that the hole for loading source is visable. Load the source using your own manipulator with side that is not nurled facing aperture in cylinder. Screw holding screw 14 using tool 21 into cylinder (make sure not to apply to muc pressure to source).

6. take tool 21 and place it through hook on top of cylinder. Hold firmly and lift cylinder slightly, in order to be able to remove wooden block. Lower cylinder gently and completely into sleeve.

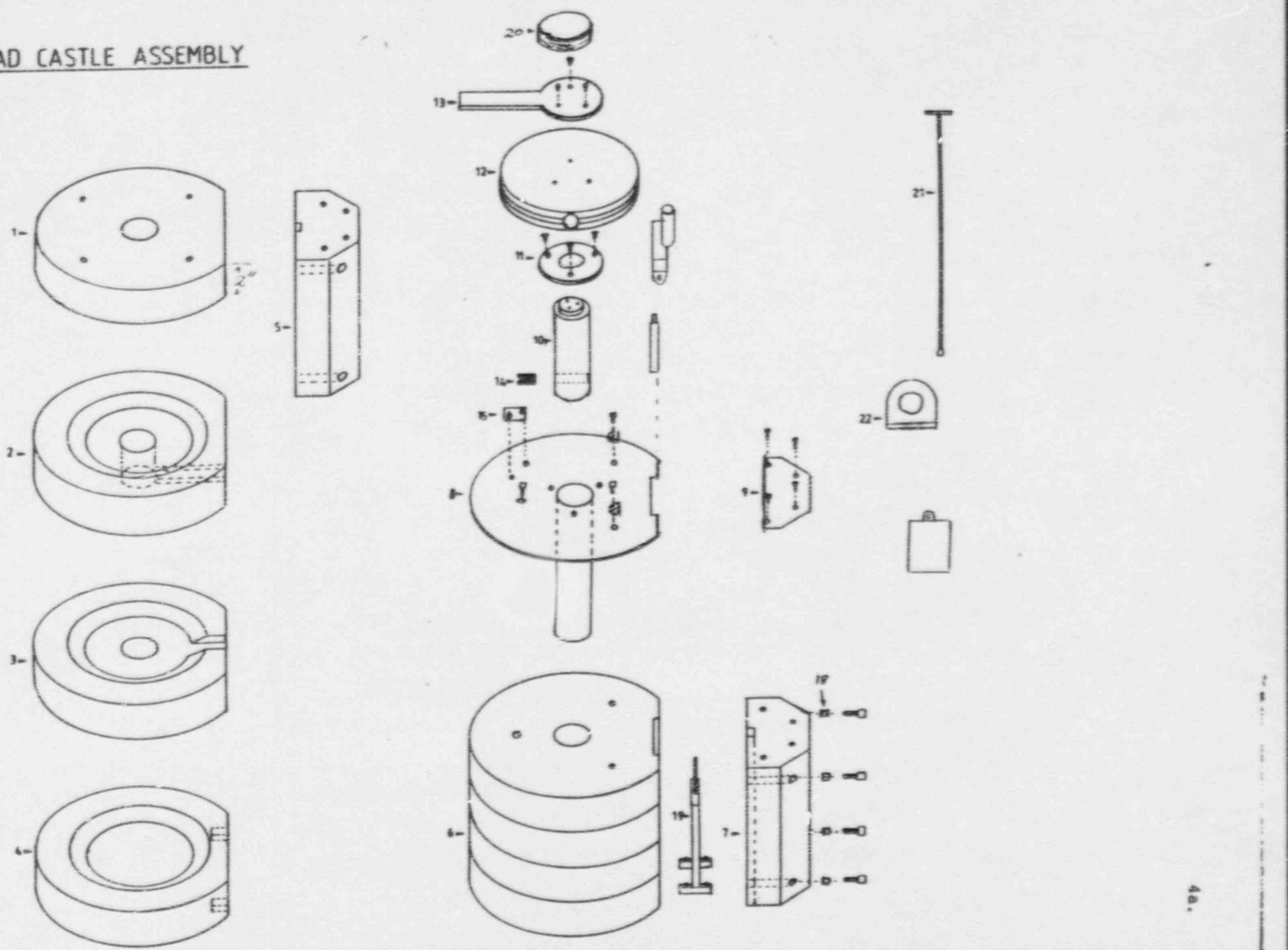
7. Remove hook. Replace screw in handle.

8. Screw sleeve 8 to lead making sure to use washers with a flat machined in the fro two holes.

9. Mount micro switch bracket to plate 8. Adjust the micro switch so that when handl is turned against the nylon stop the switch is activated.

10. Place lead cap 20 on top of handle.

LEAD CASTLE ASSEMBLY



SERVICE

The system is controlled is controlled by micro processor controller which drives two stepper drives, motors and two DC motors.
The posiition of all light barriers, limit switches and motors are indicated in Fig. 1

CHECKS

In order to check the operation of all light barriers and limit switches, simply remove the two motor drives and the five relays in the machine. (Note; these are not in the electronic console.) Note; The SD 2 drives are not interchangeable).

Switch the instrument on and operate the limit switches manually, watching to see if the respective L.E.D. on the micro processor controller turns on and off. To test the light barriers simply interupt the beam and watch the respective L.E.D. on the micro processor controller.

If switching does not occur replace the component.

FAULTS

a) No power

Check main fuse at rear on electronic console, 3,15A.

b) No LCD Display or lamps, a light on "on/off", "start" and "stop" buttons but micro processor controller is powered;

1) check fuses in SD 2 stepper motor drive module.

2) check fuse in display module 1090 on PCB in slot behind front panel. Remove front panel of module to locate fuse.

3) change "transformer" module 1069 or "SD 2 stepper motor drive".

c) No drive to a stepper motor

This can be checked by manually checking to see if a stepper motor is not powered (will rotate freely with no power locked in position)

Fault
1) no drive to one stepper motor only.

a) check fuses in respective stepper motor drive
b) change drive or motor

2) no drive to two stepper motors

a) check mains fuse
b) replace transformer module

d) No drive to DC motor

a) check respective relays located in main machine
b) check fuse 6,3A behind display module 1090. Remove front panel of module to locate fuse.

e) Magazine does not feed out of rack

1) feed motor turns but does not engage gear on magazine - check solenoid and solenoid relay.
2) check fuse behind display module 1090, fuse 6,3A.

e) Magazine feeds in and first dosimeter is pushed in front of source for irradiat but does not continue.

;) replace timer

ALIGNMENT

With no power to instrument. Only necessary when replacing a limit switch.

1) Door limit switch

Set switch in position that the door latch operates the limit switch.

2) Source limit switch

Mount handle on lead castle so that source handle operates this switch

3) Up and down limit switches

Mount so that rack operates these switches in the fully up and down positions.

4) Dosimeter down limit switch

Manually set this limit switch to a position where the magazine can move under the lead castle without hooking the dosimeter arm.

5) Dosimeter up limit switch

Place a dosimeter in a magazine and manually push the dosimeter out of the magazine up infront of the source. Set the limit switch so that it is operated before the arm has completely reached the end of its travel. This can be monitored by the brass rod protruding from the lead castle. Set switch operation $\pm$ 1 mm from full travel

With power to instrument. Only necessary when replacing a light barrier.

Make sure that the transmitter and receiver look at each other. This can be seen by monitoring the L.E.D. in the receiver unit. Position the transmitter so that the receiver L.E.D. lights with no obstical in the light path.

1) Magazine back light barrier

Remove the feed motor drive and solenoid relay mounted on the feed motor plate Take a magazine and move it manually until it just moves into the light barrie path (ie. LED just goes off) make sure that the front of the magazine clears t upper loading plate.

2) Rack light barrier

Remove the rack motor drive. Manually turn the rack to the fully up position. Place a magazine into the lowest rack position and turn the rack down until one can manually feed the magazine through to the lead castle magazine slide. When these are level move the light barrier until it just switches on when

3) Dosimeter light barrier

Remove dosimeter and magazine stepper motor drive. Set the receiver so that when pushing a magazine with dosimeters through under the lead castle the dosimeter turns the light barrier on and off.

4) Magazine Light Barrier

Remove the rack stepper motor drive. This is a reflective type. Make sure the door on the rack is closed. Turn the rack manually from top to bottom making sure the L.E.D. comes on before the rack light barriers L.E.D. in all cases and also that they are in coincidence when the correct rack position.

5) Front of magazine detect light barrier

When rack is pushed in check that LED switches.

6) Magazine advance light barrier

Remove the dosimeter motor relays and magazine stepper motor drive. Push a magazine with dosimeters under the laed castle. Turn the magazine motor in an anti clockwise direction until the LED of the light barrier just comes on. Check that the dosimeter arm can be pushed up through the magazine. Rotate the disc containing the sixteen holes until this can be accomplished. Then lock disc to stepper motor shaft.

7) Solenoid

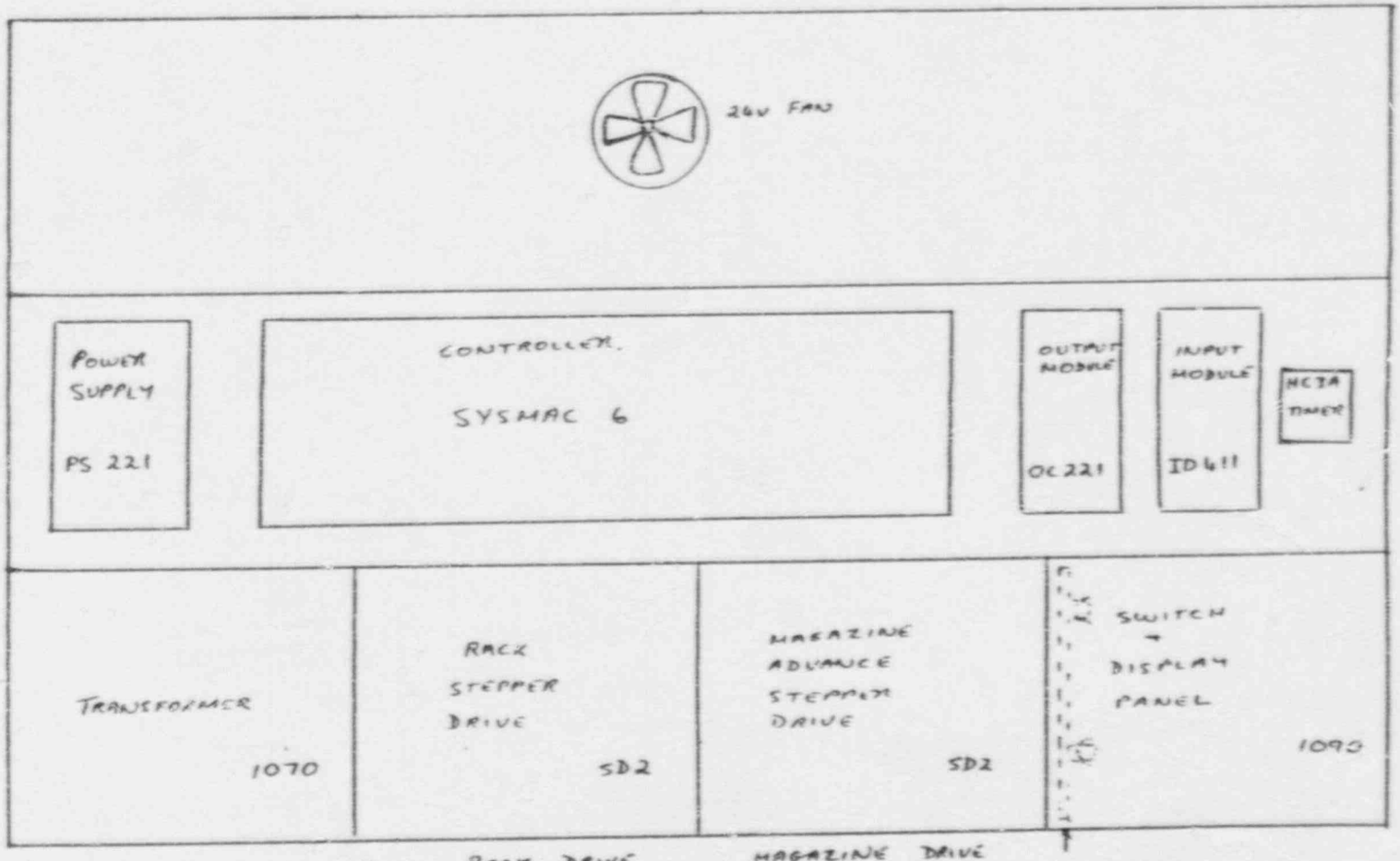
Only when replacing solenoid. Adjust soft iron bar of solenoid so that when ful in "in" position the feed motor gear meshes with magazine teeth without applyir excessive pressure to magazine.

8) When replacing magazine motor

Switch off the instrument. Push a rack through under the lead castle. Move the motor mounting forward until the motor gear meshes with the magazine's gear teeth.
Tighten the holding screws lightly. Feed a magazine in until it just touches th gear and make sure that the dosimeters arm is able to move freely through the magazine's. Lock the motors in position.

MICRO PROCESSOR	INPUTS
0	START
1	RACK UP LIMIT SWITCH
2	RACK DOWN LIMIT SWITCH
3	MAG LIGHT BARRIER
4	FRONT MAG LIGHT BARRIER
5	DOSIMETER LIGHT BARRIER
6	DOSIMETER UP LIMIT SWITCH
7	DOSIMETER DOWN LIMIT SWITCH
8	MAG ADVANCE LIGHT BARRIER
9	SOURCE LIMIT SWITCH
10	RACK LIGHT BARRIER
11	BACK MAG LIGHT BARRIER
24	STOP
25	POWER FAIL CONTACT
26	DOOR LIMIT SWITCH
27	TIMER CONTACT

	OUTPUTS
12	DIRECTION RACK MOTOR
13	SLOW RACK MOTOR
14	DIRECTION MAG MOTOR
15	SLOW MAG MOTOR
16	DIRECTION DOSIMETER MOTOR
17	SLOW DOSIMETER MOTOR
18	SLOW FEED MOTOR (SOLENOID)
19	DIRECTION FEED MOTOR
20	POWER FAIL
21	DOUBLE RACK
22	BUZZER
23	TIMER



NOTE: RACK DRIVE IS SET FOR 2A POWER TO MOTOR

DIP SWITCHES ALL OFF

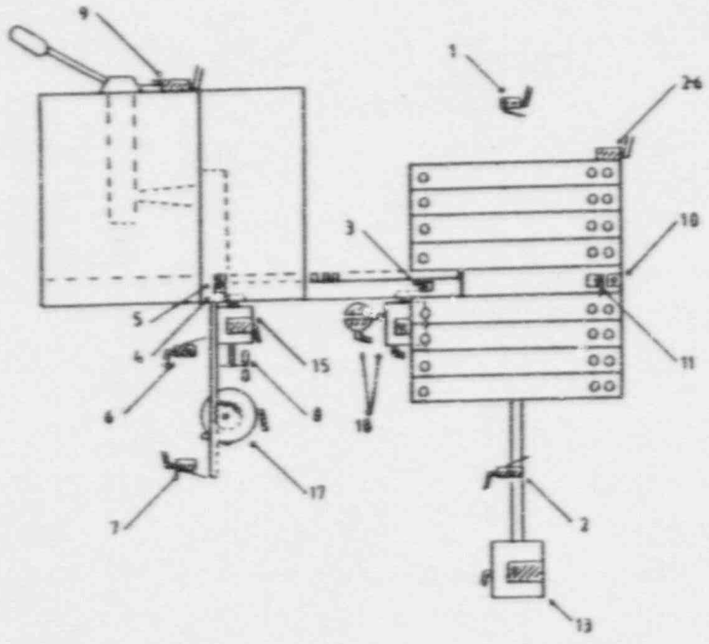
MAGAZINE DRIVE IS SET FOR 1A POWER TO MOTOR

DIP SWITCHES No 1 ON OTHERS OFF

PCB WITH FUSES FOR SOLENOID + DC MOTORS

86 PIN LOWER RACK	86 PIN TOP RACK	48 PIN REAR	SYSMAC LEAD NO	WIRE NO	DESCRIPTION
	B	A	1		RACK UP L/S
	C	B	2		RACK DOWN L/S
	D	C	3	53	MAGAZINE L/S
	F	E	5	54	DOSIMETER L/S
	E	D	4	58	FRONT MAG. L/S
	G	F	6		DOS. UP L/S
	H	G	7		DOS. DOWN L/S
	J	H	8	55	MAG. ADV L/S
	K	J	9		SOURCE L/S
	L	K	10	56	RACK L/S
	M	L	11	57	MAG. RACK L/S
	T	N	16	66	DIRECTION DOS. MOT
	U	P	17	67	START DOS. MOTOR
	W	V	19	68	DIRECTION FEED MOT
	V	U	18	69	START FEED MOTO
K	N		12		DIRECTION RACK MOT
L	P		13		START RACK MOTO
M	R		14		DIRECTION MAG. MOT
N	S		15		START MAG. MOTO
Z	X		20		POWER FAIL LED
Y	Y		21		DOUBLE MAG. LED
i	Z		22		BUZZER
a	a		24		STOP SWITCH
b	b		25		POWER FAIL CONTA
	c	M	26	38	DOOR L/S
J	A		0		START SWITCH
f		e		61	RACK CLOCK } DR
g		i			RACK RESET }
h		a		59	DOS CLOCK } DR
j		c		60	DOS RESET }
		R			CHASSIS
A		S		69	ORANGE } RACK
B		i		67	BLACK } STEPPER
C		h		50	YELLOW } MOTOR
D		s		48	RED } WIRES
E		T		43	ORANGE } MAGAZINE
F		J		41	BLACK } ADVANCE
G		v		44	YELLOW } STEPPER
H		u		42	RED } MOTOR WIRES
d	d f	Y		62/63	+24V DC
e	e g	Z		64/65	0V DC
m		b			SOURCE LED
k		f			RACK LED
P		x		74	+26V } SOLENOID
R		y		60	-26V } POWER
S		W		73	+10V } DC MOTO
T		X		72	-10V } POWER
W					SWITCHED LIV
					MPINS.

L/S = LIMIT SWITCH



1 Rack up L/S
2 Rack down L/S
3 Mag back L/B
4 Front mag L/B
5 Dosimeter L/B
6 Dosimeter up L/S
7 Dosimeter down L/S
8 Mag advance L/B
9 Source L/S
10 Rack L/B
11 Rear mag L/B
13 Rack motor
15 Mag advance motor
17 Dosimeter motor
18 Solenoid - Feed motor

L/S = Limit Switch
L/B = Light Barrier

Fig. 1

SD2 and SD3 STEPPER DRIVES

Edge Connections

2a	Motor phase 2A	2c	Motor phase 2A
4a	Motor phase 2B	4c	Motor phase 2B
6a	Motor phase 1B	6c	Motor phase 1B
8a	Motor phase 1A	8c	Motor phase 1A
10a	+24v DC out	10c	+24v DC out
12a	Logic supply input 1	12c	Motor supply input 1
14a	Logic supply input 2	14c	Motor supply input 2
16a	0v	16c	0v
18a	0v	18c	0v
20a	Fast input	20c	Fault output
22a	Slow input	22c	Zero phase output
24a	Rate adjust common	24c	Slow rate adjust
26a	Fast Rate adjust	26c	Direction input
28a	Internal clock output	28c	Clock input
30a	Sync (input or output)	30c	Energise input
32a	External reference input	32c	Signal 0v

List of link functions

Link 1 (insert) Sets the sync pin to an output, making the drive a "master". This link must be fitted when there is only one drive in the system. The chopper regulator produces 5v 1uS pulses on the sync output.

Link 2 (do not insert) Sets the sync pin to an input, making the drive a "slave". All interconnected drives in a multi-axis system should have link 2 fitted except the master drive which should have link 1.

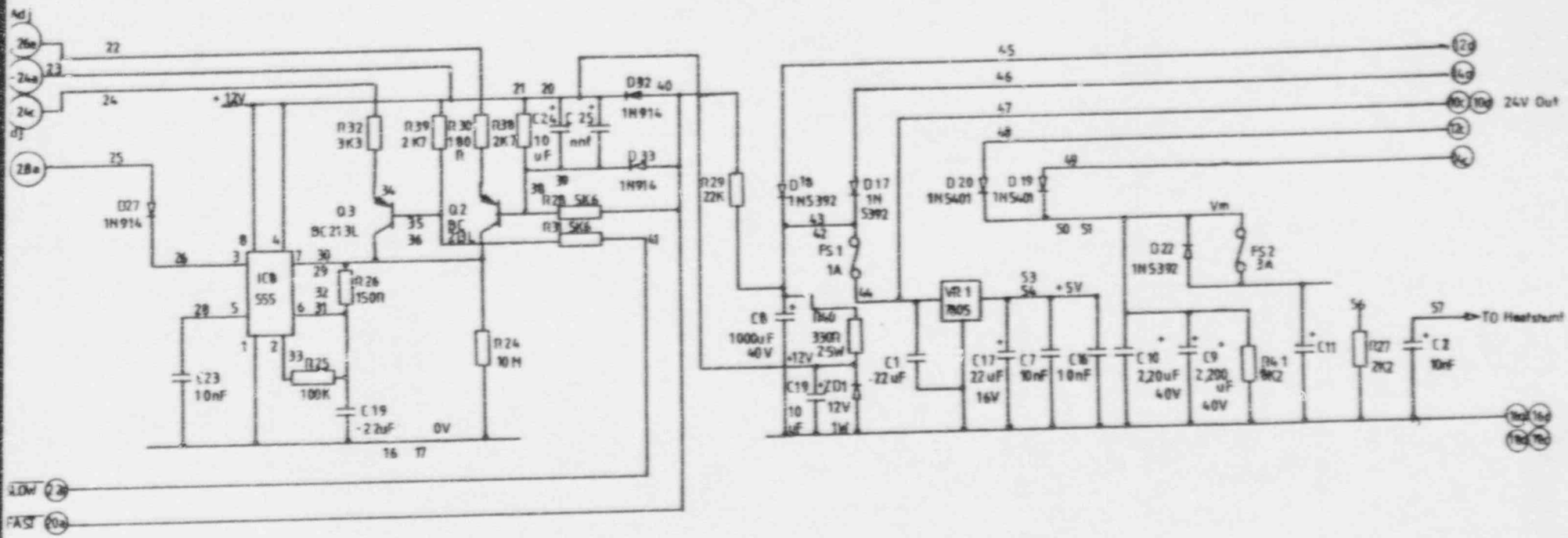
Link 3 (do not insert) Fit this link to operate in the full-step mode. A standard stepper motor will produce 200 steps/rev with this link fitted, and 400 steps/rev without. The 400 step/rev mode is to be preferred in most applications, the slight torque loss being offset by smoother operation at low speeds.

Link 4 (insert) With this link fitted the drive will remain energised without the need to make an external cinnection from the "energise" input to 0v.

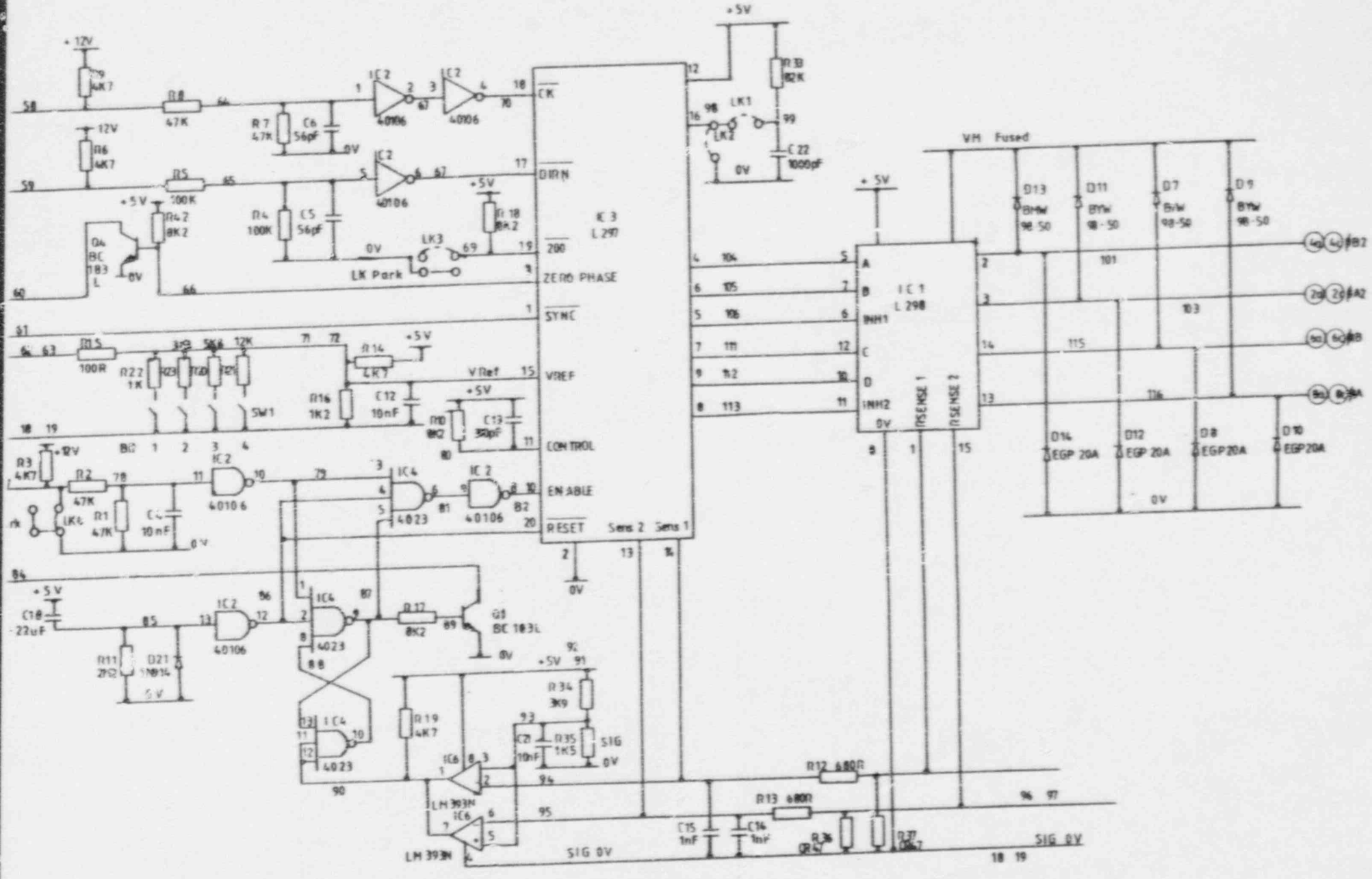
Setting the motor current

Nominal current		Switch settings			
SD2	SD3	1	2	3	4
1A	1.5A	on	off	off	off

STEPPER DRIVE CIRCUIT



STEPPER DRIVE CIRCUIT

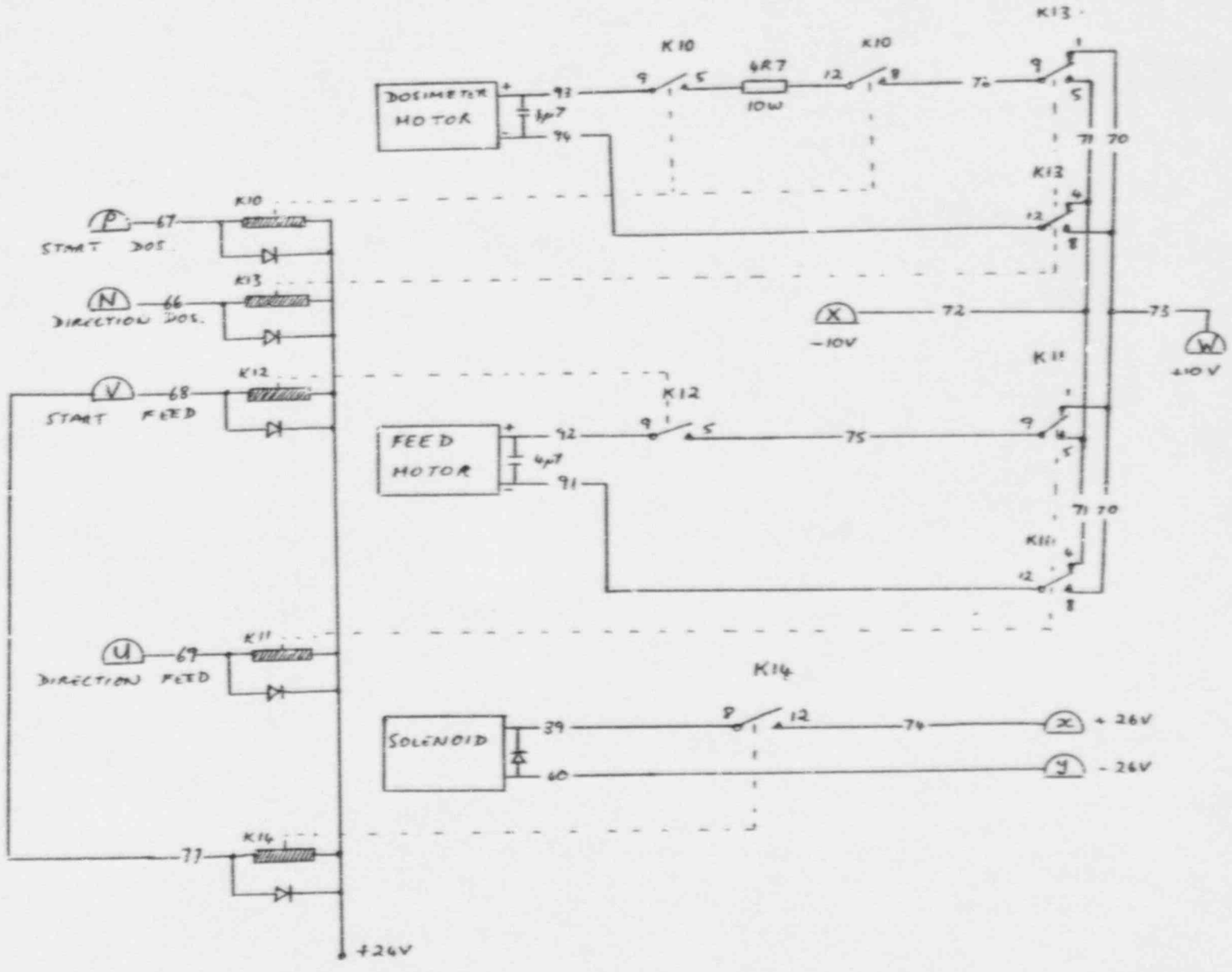


RELAY SWITCHING.

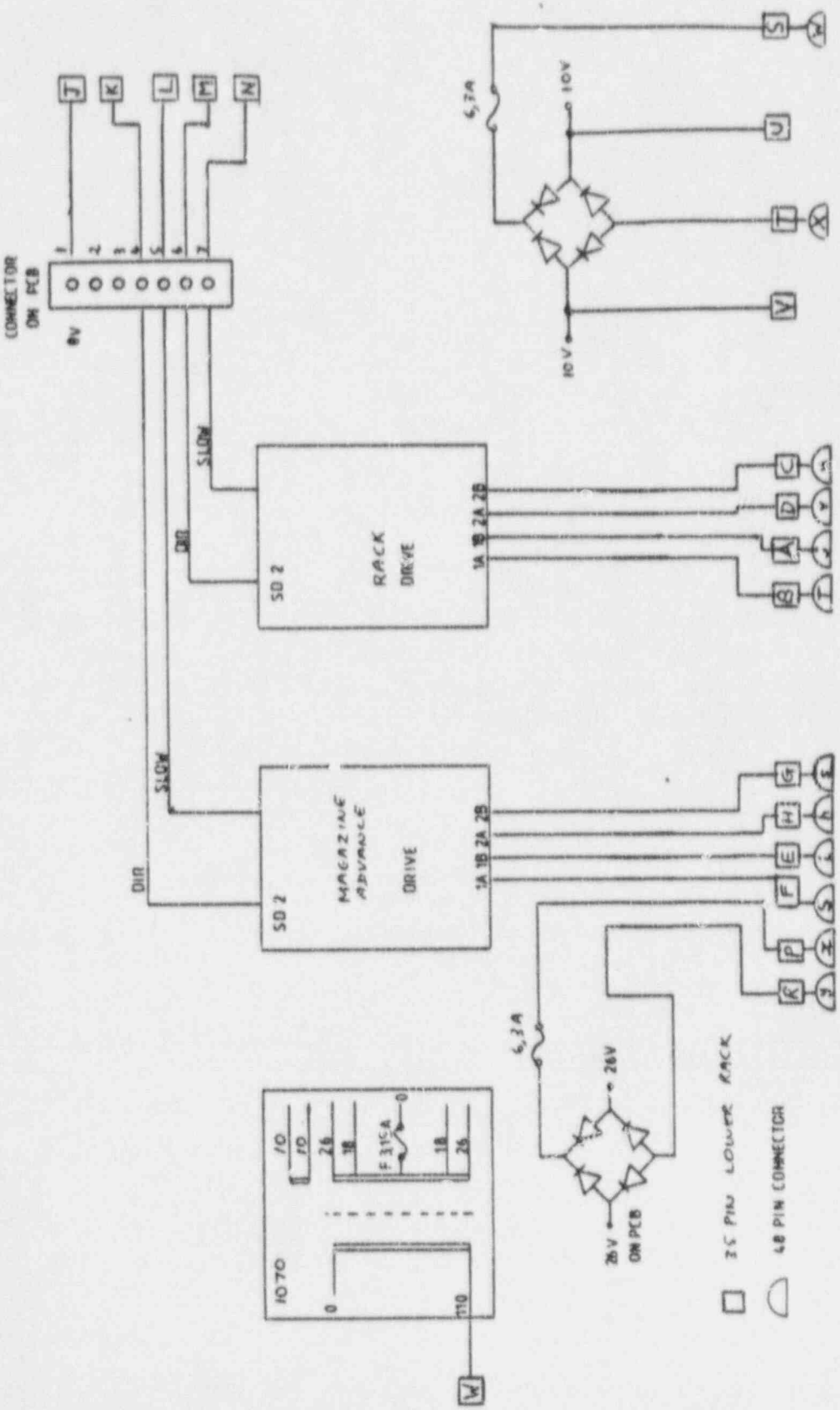
TOP

RELAYS

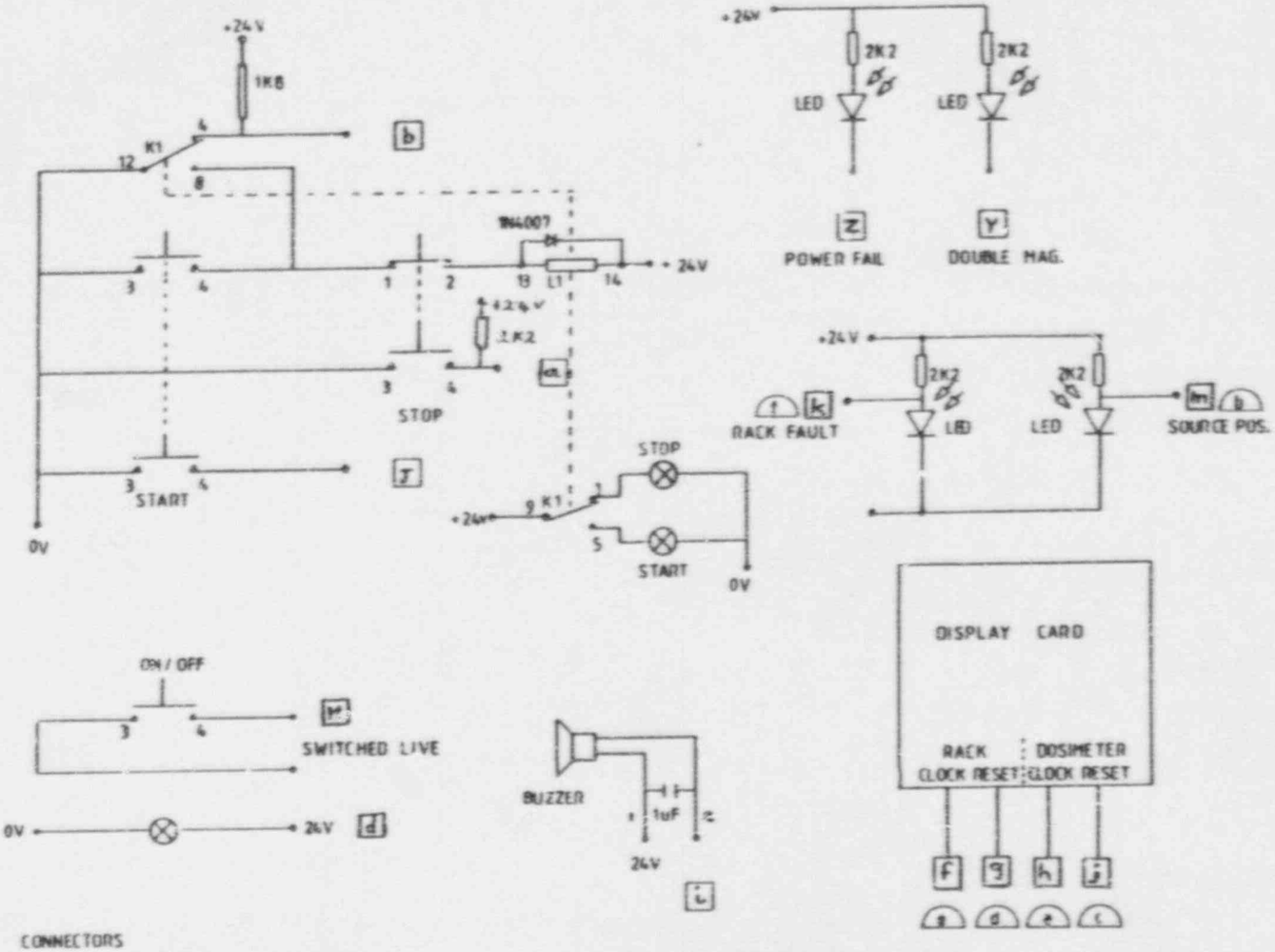
START DOS. MOTOR	K10
DIRECTION FEED MOTOR	K11
START FEED MOTOR	K12
DIRECTION DOS. MOTOR	K13
SOLENOID	K14



DRIVE CIRCUIT



SWITCH CIRCUIT



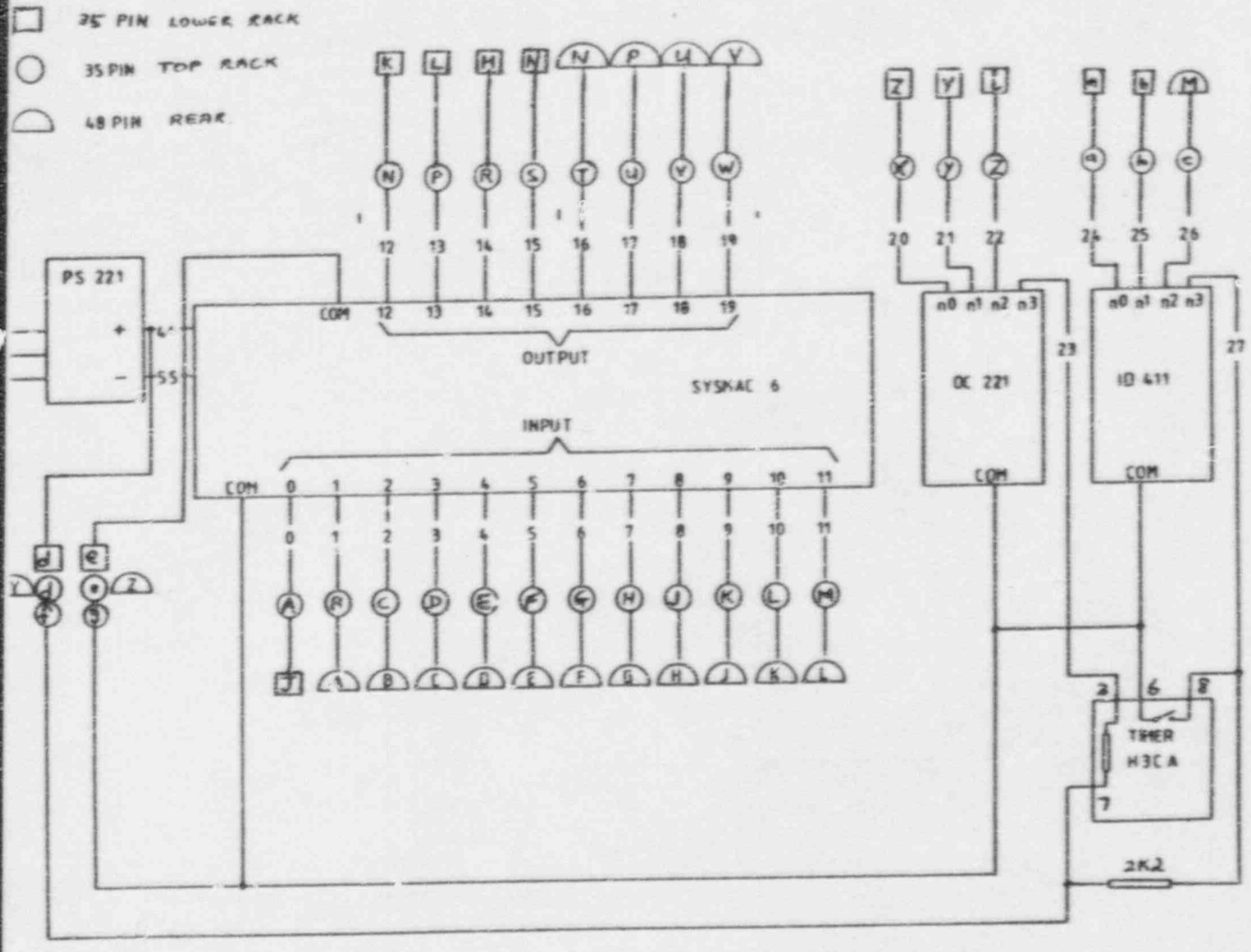
CONNECTORS

□ 35 PIN LOWER RACK

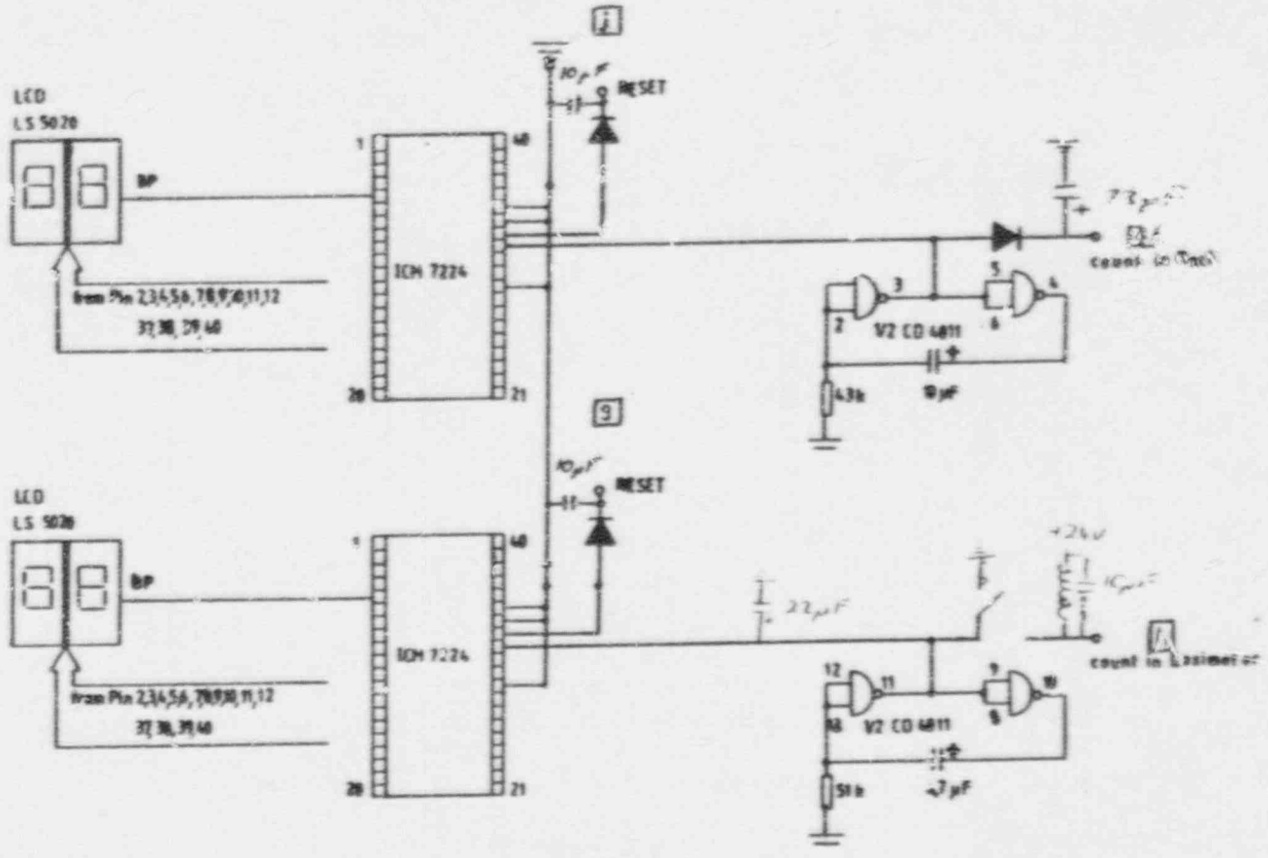
⌓ 48 PIN REAR

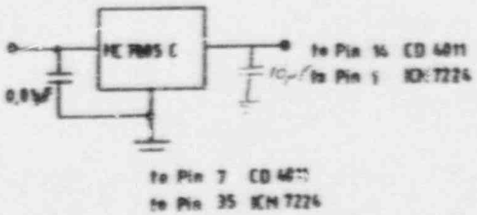
CONTROL CIRCUIT (TOP RACK)

CONNECTORS.

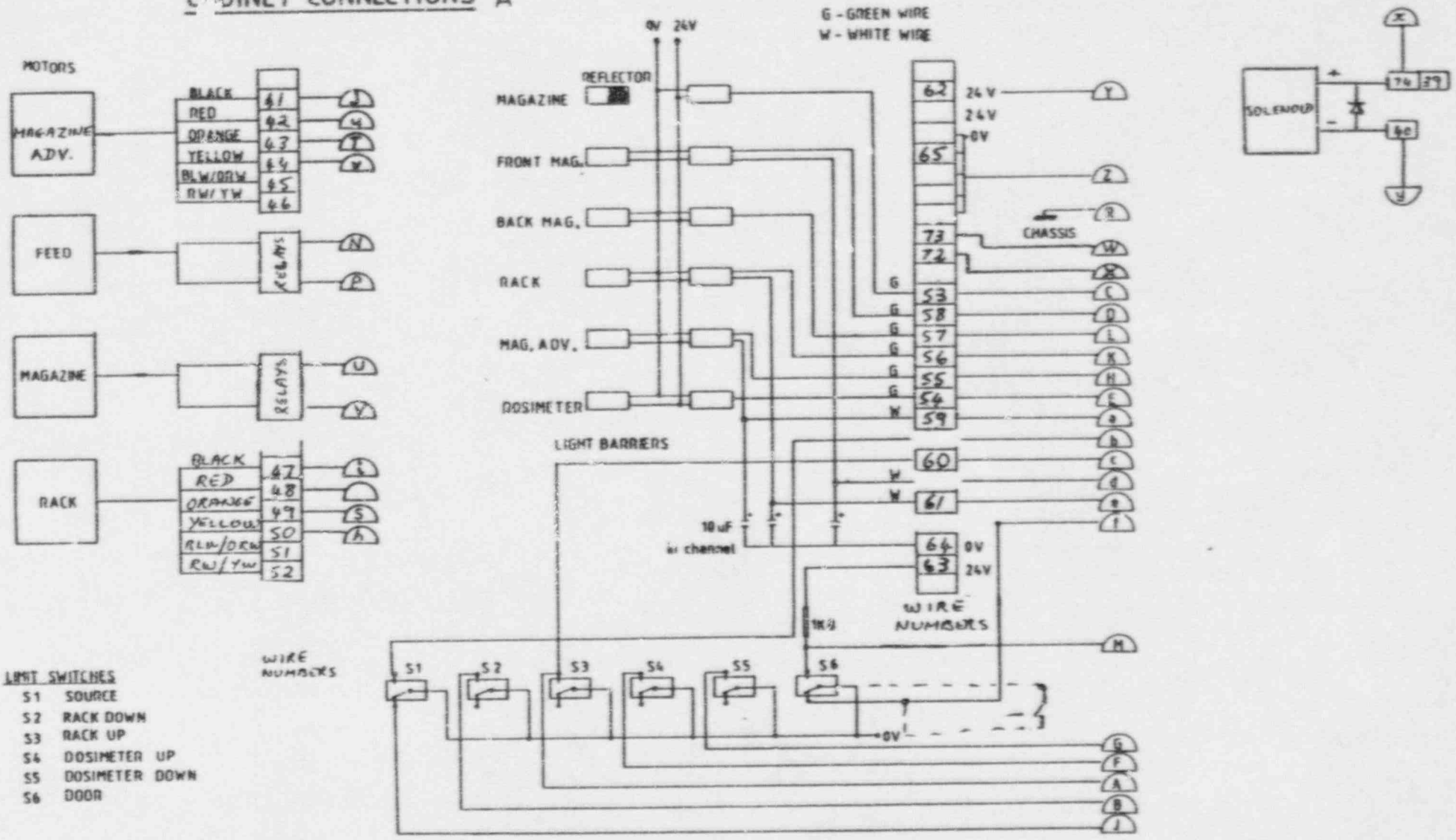


Counter / Display Board





CABINET CONNECTIONS 'A'



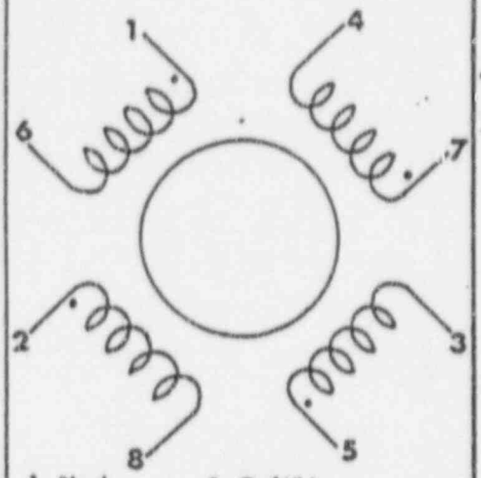
LIMIT SWITCHES

- S1 SOURCE
- S2 RACK DOWN
- S3 RACK UP
- S4 DOSIMETER UP
- S5 DOSIMETER DOWN
- S6 DOOR

MAE Conn.

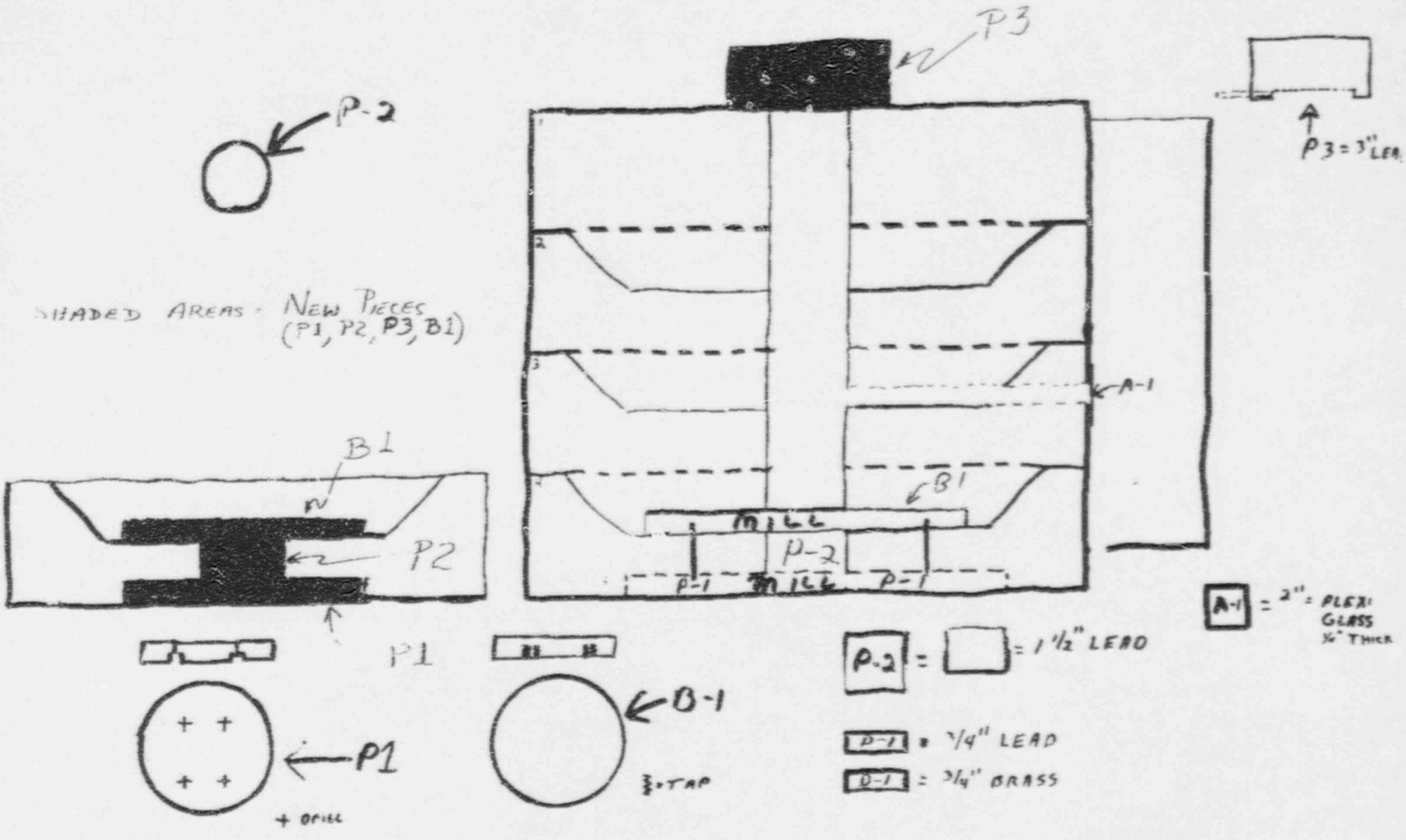
MAE Stepping Motor Connections

DRIVE OUTPUTS & CONNECTION TYPE

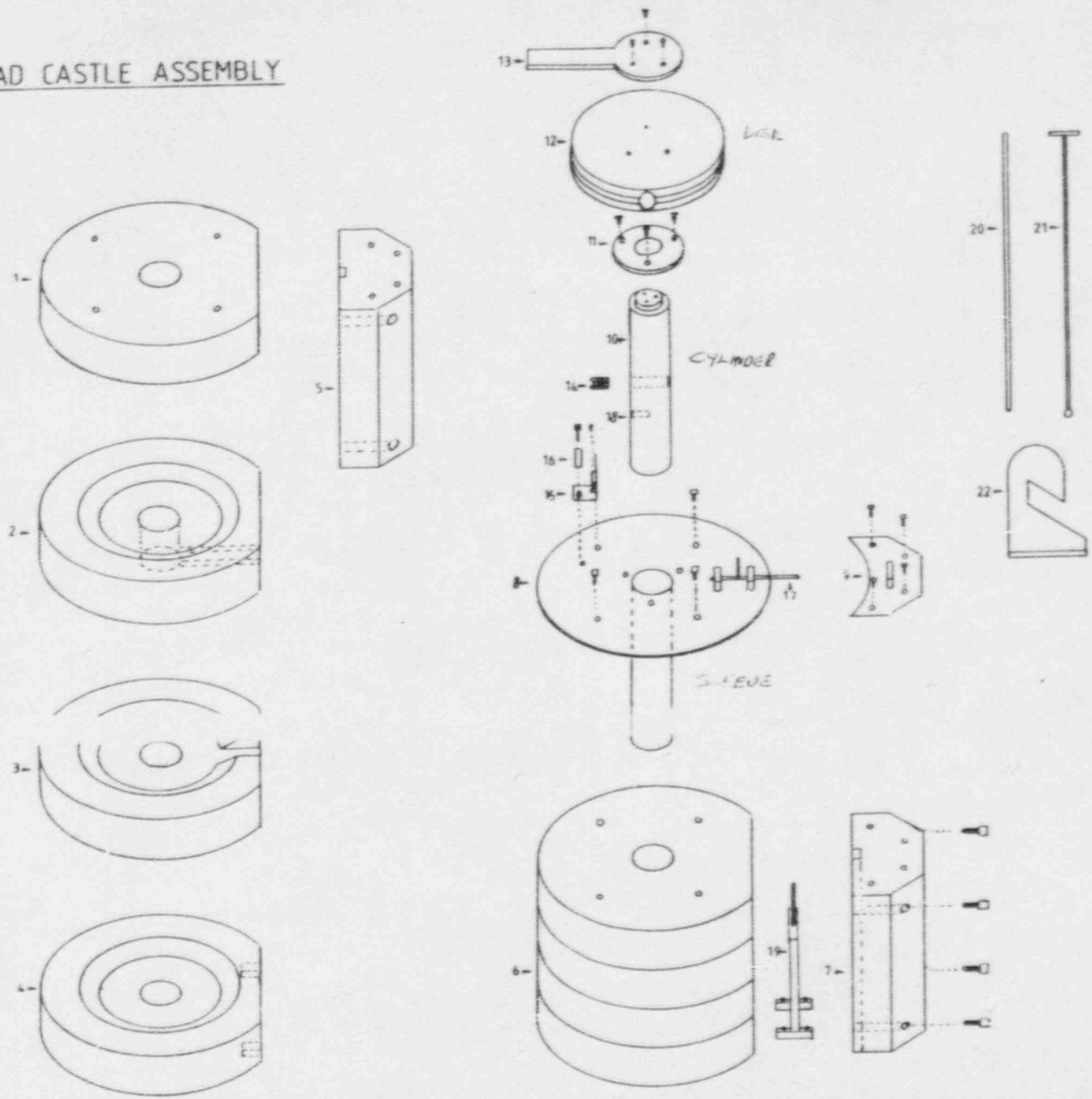


1 Black
2 Red
3 Orange
4 Yellow
5 Or/White
6 Bl/White
7 Yl/White
8 Rd/White

UNIPOLAR	TERMINAL	COLOUR
Ø 1	1	Black
$\overline{Ø 1}$	3	Orange
Ø 1 Common	5 & 6	Wh/Or & Wh/Blk - (LINK)
Ø 2	2	Red
$\overline{Ø 2}$	4	Yellow
Ø 2 Common	7 & 8	Wh/Yw & Wh/Rd - (LINK)
BIPOLAR SERIES		
Ø 1	1	Black
$\overline{Ø 1}$	3	Orange
Ø 2	2	Red
$\overline{Ø 2}$	4	Yellow
Isolate - (LINK)	5 & 6	Wh/Or & Wh/Blk
Isolate - (LINK)	7 & 8	Wh/Yw & Wh/Rd
BIPOLAR PARALLEL		
Ø 1	1 & 5	Black & White/Orange
$\overline{Ø 1}$	3 & 6	Orange & White/Black
Ø 2	2 & 7	Red & White/Yellow
$\overline{Ø 2}$	4 & 8	Yellow & White/Red


P-2
P3
P3 = 3" LEAD
SHADED AREAS = NEW PIECES (P1, P2, P3, B1)
A-1
B1
P2
P1
P-2
P-1
MILL
B-1
+ DRILL
TAP
P-2 = 1 1/2" LEAD
P-1 = 1/4" LEAD
B-1 = 3/4" BRASS
A-1 = 2" = PLEXI GLASS 1/4" THICK

LEAD CASTLE ASSEMBLY



SUMMARY DATA

Date — July 31, 1987

Applicant — Panasonic Industrial Company (distributor)
Two Panasonic Way
Secaucus, New Jersey 07094

Contact: Mr. David Katzman
Marketing Director
(201) 348-5339

Device Type — Self-shielded irradiator

Model — WE 2001 Series

Other Companies Involved

Williston Elin (manufacturer)
Schiefe Barte II
D3414 Hardengsen
West Germany

Radioactive Source Model Designation

Cesium-137, model X-38, from Amersham

Radionuclide and Maximum Activity

Each irradiator will be loaded with a double encapsulated source of cesium-137. The activity will generally be approximately two curies per source with one source per irradiator. The maximum activity will be six curies per source.

Leak-Test Frequency

Minimum of once every six months.

Principal Use Code

Code J, Gamma Irradiator, Category I
The device is proposed for use under the specific license of a user.

Custom Device

Not a custom device.

Custom User

Not a custom device.

SUMMARY DESCRIPTION

Written Description

This device is used exclusively to irradiate Panasonic thermoluminescent dosimeters (TLDs). An operator can load a maximum of 50 Panasonic TLDs in a magazine, and he can load a maximum of 10 magazines into the device. The magazines are stacked on an elevator that is in a separate chamber from the location of the cesium-137 source. A preset irradiation time is then entered into the device. The device automatically moves one TLD at a time near the cesium-137 source for irradiation. Guide tubes are large enough to permit the TLDs to be moved near the source, but they are small enough to prevent the operator from getting any part of his body, including fingers, near the source. When all of the TLDs have been irradiated, the operator removes the magazines from the elevator.

The device is a cabinet that is approximately 125 cm wide, 90 cm tall, and 50 cm deep. The cabinet is on casters but is too heavy to be considered portable. It is intended to be used in a fixed location.

The cabinet is divided into two chambers. One chamber contains the elevator that can hold a maximum of 10 magazines, and the other chamber contains the cesium-137 source. A bulkhead separates the two chambers. A hole in the bulkhead is slightly larger than the cross-sectional dimensions of a magazine (about 7 cm by 3 cm) to permit the movement of one magazine at a time from the elevator chamber to the irradiation chamber.

Access doors to the two chambers are keyed separately. An operator must open and close the access door to the elevator chamber each time TLDs are loaded and unloaded, but there is no reason for the operator to unlock the door to the irradiation chamber during routine use of the irradiator.

The source housing does not move during use. Instead, three stepping motors are used; one motor moves the elevator up and down, one motor moves a magazine in and out of the irradiation chamber, and one motor moves a TLD in and out of the magazine for irradiation.

The cesium-137 source is installed in a lead shield by a Panasonic service person. The shield is bolted together and is disassembled only by an authorized service person. The shield is a right circular cylinder that is 16 cm in diameter and 20 cm high.

Drawing

The Appendicies A, B, and C to this document contain information supplied by the manufacturer. Drawings and photographs of the device are included.

DETAILS OF CONSTRUCTION AND USE

Conditions of Use

The purpose of this device is to irradiate Panasonic TLDs to gamma rays from cesium-137. Since the device will only accommodate special magazines that contain Panasonic TLDs, it is not possible to use the device to irradiate other brands of TLDs, or to irradiate anything other than Panasonic TLDs.

The environmental conditions in which the device will be used are expected to be typical of those found in a TLD processing laboratory. It is expected that the laboratory air will be cool, clean, and at low humidity. No excessive vibrations or other environmental stresses are anticipated.

The devices will be used by processors of personnel dosimetry that use Panasonic TLDs. These processors are primarily nuclear power plants. Other

users might include commercial suppliers of personnel dosimetry, DOE facilities, and primary dosimetry groups of the military.

The device will probably be used on a frequent basis by any of a few technicians at a dosimetry facility. The primary use of the device is to irradiate Panasonic TLDs to produce an element correction factor (ECF) for each element of each dosimeter. These ECFs are generally re-evaluated by a processor on an annual basis. The technician will load and unload magazines in the elevator compartment but will not open the irradiator compartment.

The expected useful life of the device is essentially the same as the life of a Panasonic TLD system at a given dosimetry facility. The long half life (30 years) of cesium-137 means that the source should never be replaced once it is installed. Use of the device by a facility that processes Panasonic TLDs will probably be an integral part of their dosimetry program.

Details of Construction

Appendix B contains drawings of the device. The cabinet and all mechanical and electrical parts (except for the cesium-137 source) are manufactured and assembled by Williston Elin and shipped to Panasonic. A processor of Panasonic TLDs will order the device from Panasonic, and the processor will order a cesium-137 source from Amersham. The source will be loaded by a Panasonic service person into the source cylinder shown in page B.2 at the dosimetry processor's facility (see Installation below). The source cylinder is then secured in the lead shield in the irradiation chamber of the cabinet as shown on page A.9.

The source is fixed in the source cylinder so that it is always irradiating the TLD irradiation position shown on page A.9. The irradiation position can be reached only by a TLD that has been moved into place by

three stepping motors. One stepping motor controls the elevator in one chamber of the cabinet, one motor moves a magazine of TLDs from the elevator into the irradiation chamber, and one motor moves a TLD from the magazine to the irradiation position. Thus, it is not possible for a person to get fingers or other parts of the body in the irradiation position. Figure 1 summarizes the maze that exists from the elevator chamber of the cabinet to the irradiation position.

Labeling

A label will be attached to the outside of the cabinet. The label will contain the name of the manufacturer, the model number of the device, the serial number, the activity of cesium-137 for which the device is rated, the standard radiation symbol, and the words, "Caution - Radio-active Material."

Testing of Prototypes

The device is engineered to prevent the operator and the TLDs in the elevator from receiving more than 2.0 mR/h. The success of this engineering goal is demonstrated below under Radiation Profiles. There are no moving parts associated with the radiation source. Three stepping motors are used to move a TLD into the irradiation position. Failure of a stepping motor would not change the dose rate to the operator.

Quality Control

After each device has been loaded with a cesium-137 source by a Panasonic service person, the service person will measure exposure rates in a method that is similar to the procedure described below under Radiation Profiles. If any location that is accessible to an operator is found to

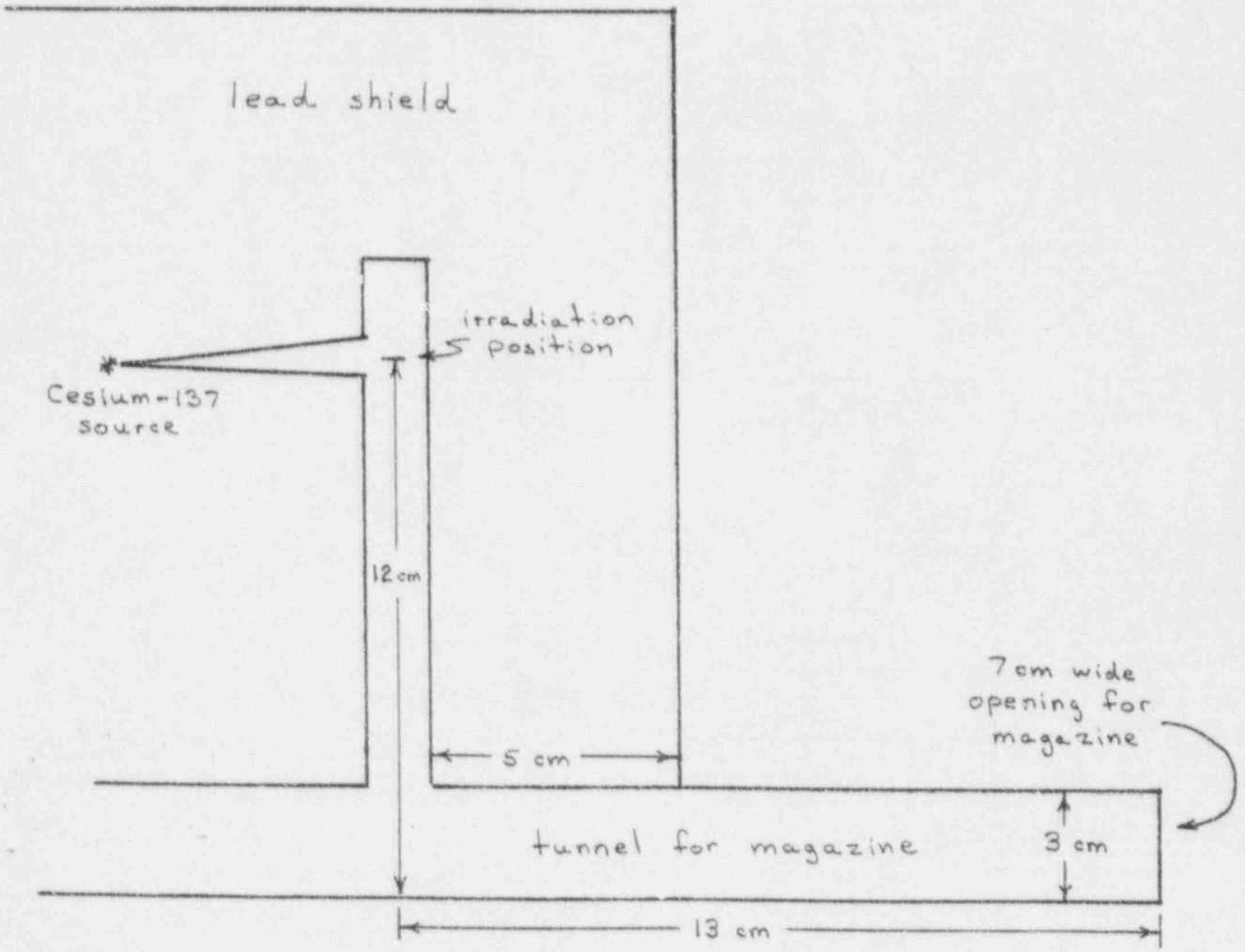


Figure 1. Diagram showing the path from the elevator chamber to the irradiation position.

produce an exposure rate of more than 2.0 mR/h, corrective action will be taken by Panasonic.

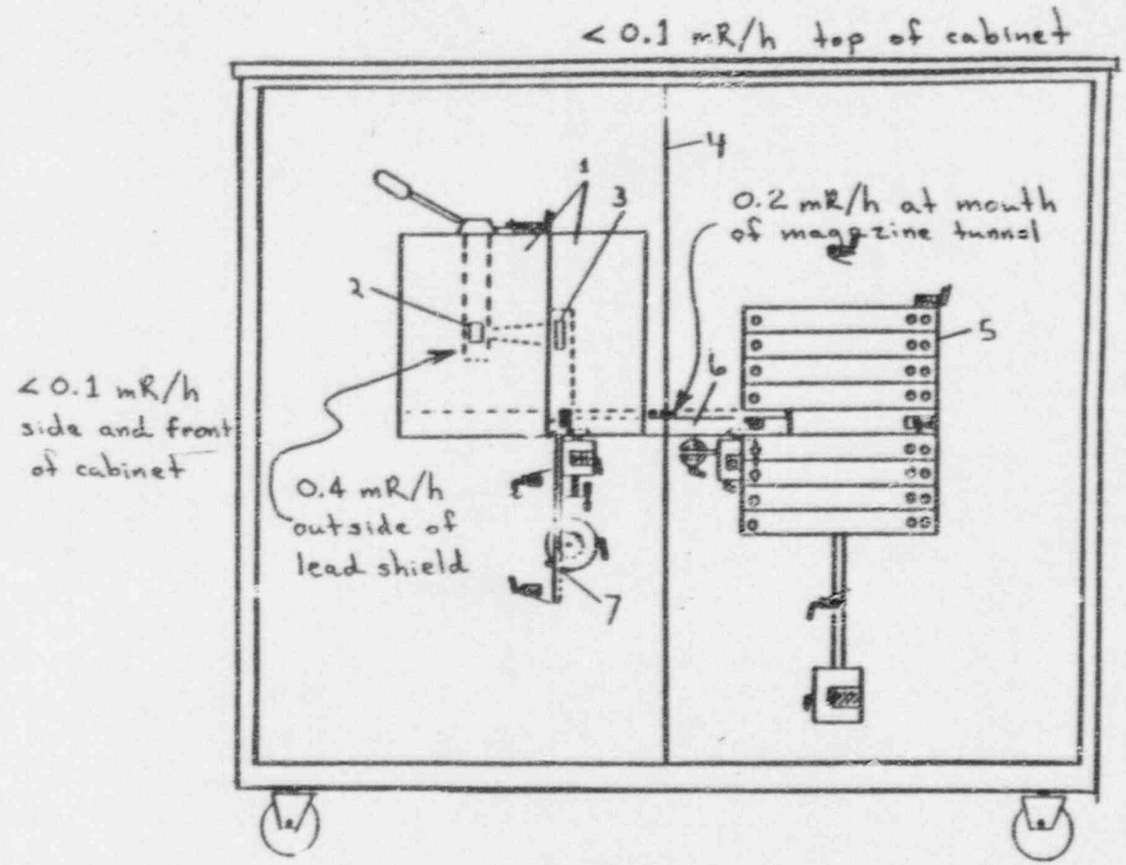
Radiation Profiles

A prototype of the device, located at the University of Michigan, was examined for exposure rates in and around the device. The results are shown in Figure 2. An Eberline RO-2 survey meter, serial no. 2315, was used to measure the exposure rates shown in Figure 2. This survey meter had been calibrated to cesium-137 within one month of being used to make the measurements shown in Figure 2.

The prototype device at the University of Michigan was loaded with a 6 curie source of cesium-137 when the exposure rate measurements shown in Figure 2 were made. This is the maximum activity that will be used in the device. Generally, a 2 curie source will be used, and some licensees will use less than 2 curies of cesium-137.

Installation

As discussed above, the device will be purchased from Panasonic by a licensee, but without the cesium-137 source. The source will be purchased from Amersham by a licensee and shipped to the licensee in a DOT approved shipping container. A Panasonic service person will then come to the licensee's facility and transfer the cesium-137 source from the shipping container to the source cylinder shown on page B.2. The service person then secures the source cylinder in the lead shield located in the irradiation chamber of the cabinet as shown on page A.9. Finally, the service person will survey the cabinet as shown in Figure 2 to confirm and document that the exposure rates in and around the cabinet are less than 2.0 mR/h.



1. Lead pig
2. Source
3. TLD irradiation position
4. Divider/Shielding
5. Magazine rack
6. Magazine
7. Dosimeter drive

Figure 2. Exposure rate profiles made on a prototype device at the University of Michigan using an Eberline RO-2 survey Meter.

The operator of the device has limited accessibility to the cesium-137 source. The operator is able to unlock the door to the elevator chamber to load and unload magazines of Panasonic TLDs. The operator will not need the key to the irradiation chamber to operate the device.

Radiological Safety Instructions

The primary radiological safety instructions for the device are incorporated in the Operating and Service Manual (Appendix A) and in the Operating Instructions Manual (Appendix C). Copies of these two manuals will be furnished to the licensee with the device. In addition to these two manuals, the licensee will be provided with a copy of the exposure rates measured by Panasonic in and around the device at the time the cesium-137 source is loaded into the device. Panasonic will recommend to the licensee that the device be leak tested at intervals not to exceed 6 months.

Documentation Accompanying the Device

No documentation, other than the Radiological Safety Instructions described above, will be supplied by Panasonic to a licensee who purchases a device. The licensee will obtain documentation concerning the cesium-137 source from Amersham.

Servicing

When the cesium-137 source is installed in the device by a Panasonic service person, radiation profiles will be made and a copy of the radiation profiles will be left with the licensee. Panasonic will offer an optional service contract to the licensee to maintain and repair the electrical and mechanical components of the device. Panasonic will also offer to provide a

repair service for the device even if the licensee chooses not to have a service contract. In addition, Panasonic will offer to provide miscellaneous services such as source replacement and training of operators.

Leak Testing

Panasonic will recommend to the licensee that leak testing of the device be performed at intervals not to exceed 6 months.

Safety Analysis

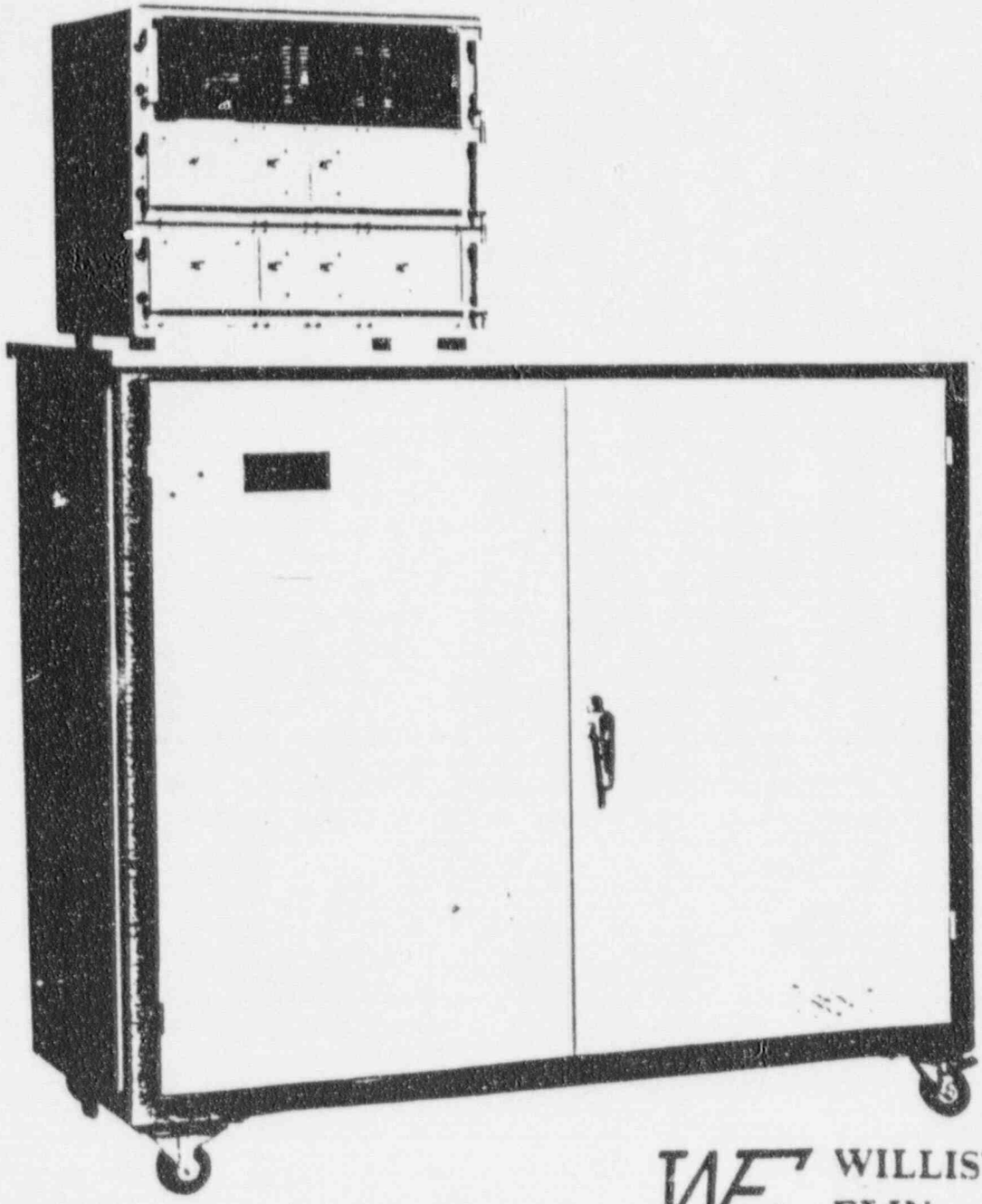
The primary information that Panasonic will provide to the licensee pertaining to the safety of the device is discussed in the Radiological Safety Instructions above. Panasonic will verify that the licensee has a copy of the Operating and Service Manual (Appendix A) and the Operating Instructions Manual (Appendix C). Panasonic will determine that the device is operating correctly and safely at the time the cesium-137 source is loaded into the device.

APPENDIX A

Operating and Service Manual for the
WE 2001 Series TLD Irradiator.

ALD IRRADIATOR

ME 2001 SERIES



WE WILLISTON ELIN

Williston Elin

TLD IRRADIATOR WE 2001 PC

USER'S MANUAL

Ver: 01/04/89 AF

App.

INDEX

INTRODUCTION

1) GENERAL

1.1 Features

The TLD Irradiator can accomodate 10 magazines (racks) of 50 dosimeters.

The Irradiation source is an Amersham Cs137 2Ci Part No. CDC 3822.

Menu-Driven Friendly System.

Controlled by two microprocessor cards incorporated in the computer.

All electronics incorporated in the main housing of the Irradiator.

Source encapsulated in a minimum of 4 inches of lead.

Irradiation of dosimeters done sequentially and fully automatically.

Not all slots or positions have to contain dosimeters.

Irradiation times can be set for individual dosimeters.

1.2 SYSTEM CONFIGURATION ACER 915 COMPUTER

MS DOS Operating System.

Central Unit with 512k RAM Memory.

Parallel Output for printer.

Black and White Monitor.

1.2 Mb Floppy.

Keyboard.

Optional 80 Column Printer.

2) SYSTEM SOFTWAR

2.1 MAKING A COPY OF A FLOPPY DISK

The copy command for making a back-up will not work.
In order to make a copy of the Diskette enter:

DISKCOPY a: a:

This should be done immediately when receiving your system and the original Disk stored in a safe place.

2.2 MENU SYSTEM OPERATION AND KEYBOARD

The Menu System represents most attractive features.

Each operation function to be performed requires a selection of parameters to define the function.

The computer can be used to run other software when the Irradiator is not in use.

Note: When jumping out of the Irradiator software the computer will turn the Irradiator "off".

3) SYSTEM INSTALLATION

The left side of the Irradiator has four outlets.
The mains input is marked "mains" and should be plugged into the wall socket. Connect the outlet "Computer Mains" to the computer power and both the "Stepper PCB" cable and "Digital I/O" cable to the respective connectors at the rear of the computer.

Note: Make sure not to connect these cables wrongly.

Place the floppy disk into the drive, close the drive door and switch the computer on.

The Irradiator Program will load itself.

The message "Loading Irradiator Software
CtrlAltDel BOOT STATUS : DEACTIVATED"

and the screen with the following logo will be displayed

"WILLISTON ELIN" Ver: 01/04/89 AF

" TLD IRRADIATOR WE 2001 PC"

3.1 PASSWORD

At the prompt

"Enter Pass Word"

type in "Williston" and press "Enter". This has been added for extra security. If an error is made while typing the password the cursor will return in order to give the user another chance. After five tries, the words "Incorrect Password, Access Denied" appear on the screen and the program is exited.
The message CtrlAltDel BOOT STATUS : RE-ACTIVATED appears and to re-enter from this point type "start" and press "enter".

3.2 DATE

At the prompt

"The current system date is 01-11-89

Is this correct Y/N"

If this is correct type "Y" for Yes.
If not type "N" for No and at the prompt

"Enter correct date"

Type in the new date in Month-Day-Year format, year being only eg. "89".

3.3 TIME

At the prompt

"The current system date is 01-11-89
The current system time is 11:40:45
Is this correct Y/N"

If this is correct type "Y" for Yes.
If not type "N" for No and type in the time in the time Hours:Minutes.

Note: We have 0 to 24 hours.
Type the time 1 minute ahead.

The prompt

"The current system date is 01-11-89
Enter correct time 11:44
Press any key to set the time"

appears and on the minute pressing any key will start the seconds rolling.

3.4 PRINTOUT OF DATA

At the prompt

"Do you want a printout of Data Y/N"

If you have a printer type "Y" for Yes and the following message is displayed

"Set Paper in Printer to Top of Page
Press and Key to Start"

If one types "Y" and has no printer or it is not switched on, or out of paper a time out will occur and the following message is displayed

"The printer is faulty or out of paper
Correct fault and press any key to continue or
press D to Disable printer"

Either press D to disable printer or correct fault.

3.5 INITIALISING

On completion of the above the Irradiator will initialise itself by clearing the racks which have been in the Irradiation Tunnel and then move the rack to the loading position.

At this time the following messages appear

"Initialising System" "Clearing Rack" and "Moving Rack to Loading/Unloading Position".

Note: The racks can only be loaded or unloaded in this position as the gate will only open when in position.

When reaching this position one of the following screens appear

a)

The Irradiation Sequence Has Been Aborted

AT

Position X

Rack X

Slot X

Dosimeter X

Press R to Resume Irradiation, I to Initialise or E to Exit

b)

Rack Now in Loading Position

Last File Used TEST Saved on 01-10-89 at 12:46:13

Do you wish to: Exit program
Use LAST Irradiation Data
Enter NEW Data
Use PREVIOUS Irradiation Data
View current list of Irradiation Files
Select E,L,N,P or V

If the Irradiation cycle previously run had been fully completed then the program would immediately go to menu (b).

Let us look at the case of (a).
Three choices are allowed.

By typing "R" for Resume the program looks at the data, being position, rack, slot and dosimeter and will resume at the next dosimeter where it last aborted its irradiation sequence.

"Position" indicates the position of the rack.
"Rack" indicates the physical number of racks.
"Slot" indicates the slot number in the rack.
"Dosimeter" indicates the total number of dosimeters already irradiated.

The message

"Advancing to next dosimeter"

This would apply if there was a power failure, an error during irradiation or stopping from keyboard.

Typing "I" for Initialize moves to the next screen and allows the irradiation sequence to be initialized.

Typing "E" exits the program to DOS.

Menu (b).

Here there are five choices
Typing "E" exits to DOS.
Typing "L" for Last uses Irradiation Data which was last entered. This is the file displayed on screen. As in this case the file name is Test Entered on 01-10-89 at 12:46:13.
If the last file cannot be found the error message "Unable to find last data file" appears.

Typing "P" for Previous will bring up the prompt

"Enter Name of Irradiation File"

Type in the name of file to be re-used and it will be read from Disk.

If the file asked for is not on disk the message "File not found" is displayed and the user can make another choice.

Typing "N" for New.

This gives the opportunity to enter new data.

The following message is displayed

"Enter number of racks to irradiate"

Here type the total number to irradiate which is only a number from 1 to 10. The program asks if this is correct. Typing "Y" for Yes moves on and "N" for No allows a change.

The program moves on and asks

"Enter Dosimeter Irradiation Data
Rack 1 Dosimeter 1 to "

Here any number from 1 to 50 is only accepted. If Data for only one dosimeter is wanted, press enter, if more than one are to have the same data enter the number, eg. 1 to 35, then the following appears. (Note: This number must be incremented to 50 even if the rack is not full of dosimeters.)

"Enter Dosimeter Irradiation Data
Rack 1 Dosimeter 1 Irradiation time Seconds"

The Irradiation time can be from a minimum of 1.0 seconds to 999.9 seconds in 0.1 second intervals.

Note: If an Irradiation time of less than 1.0 seconds is entered the computer will beep, the time will flash and be changed to 1.0 seconds.

At the end of each rack of data entered the prompt "Is this correct" appears. Type "Y" moves on and "N" allows a change.

One is then asked

"Enter File Name"

This can be a maximum of 8 alpha or numeric characters and press "Enter".

Typing "V" for view will display all the previous Irradiation files saved on disk.

Pressing any key returns to the menu.

3.6 STARTING AND SEQUENCE DESCRIPTION

The message

"Press any Key to Start"

starts the Irradiation Cycle.

The rack will now move downwards with the following message appearing

"Moving Rack to First Occupied Position"

When the first rack is found the Feed Motor will advance the rack to the Irradiation position, where the data for that dosimeter is read from the file and then the dosimeter is pushed to the Irradiation aperture in the lead castle and Irradiated for the entered time. While this is happening on screen the following message appears

"Position X Rack X Slot X
Irradiating Dosimeter X for XX.X Seconds
Iradiation Time XX Seconds"

This is an indicator for the operator of where the Irradiator is in its sequence.

The last line "Irradiation Time" is a clock which is incremented to show the elapsed time of a single Irradiation.

When a rack is completed the following message appears

"Clearing Rack
Moving to Next Rack"

After 10 positions have been completed the rack will move to the loading/unloading position and the buzzer will sound continuously.

The message

"Irradiation Cycle Completed"

and prompt appears

"Do You Want to Exit Program Y/N"

Answering "Y" for Yes exits the program to DOS. "N" for No will take the operator back to the top of the program.

3.7 STOP

To stop the Irradiator at any time type capital "S" and the following message is displayed

"Irradiator Stopped from Keyboard
Fatal Error, Program ABORTED
Press any Key to Acknowledge Fault"

The buzzer will sound. On pressing any key the buzzer is silenced and the following message is displayed

"Fatal Error, Program ABORTED
Press any Key to Shut Down Irradiator
To Resume Irradiation Prior to ABORT, Restart Program

Note: All Irradiation Data has been saved prior to ABORT"

After shutting down the Irradiator the program exits to DOS.

3.8 SELF CHECK

The Software has been designed to self test the Irradiator for operation at the beginning of the program.

Messages are displayed asking the operator to correct certain conditions before starting.

3.8.1 "Power to Irradiator Disabled"

The computer checks that the power actually exists at the Irradiator.

3.8.2 "Please Move Source to the Irradiate Position" "Press Any Key to Continue"

The Source Handle must be in position and activate the limit switch for irradiation to be possible. This ensures that the source is looking directly at the dosimeter. Move the source into position and press any key.

3.8.3 "Please Close the Irradiator Door"

This is a safety activated by the limit switch at the base of the door. All motors are stopped when the door is opened to ensure the operators safety.

3.9 ERROR MESSAGE

The Software has been designed to self test the Irradiator while in operation. If an error occurs during operation the Irradiator will stop and the following message is displayed.

" x x x x x x x x x x"
Fatal Error, Program ABORTED
Press any Key to Acknowledge Fault

The buzzer will sound. This will be stopped by acknowledging fault.

The next message is displayed

"Fatal Error, Program ABORTED

Press any Key to Shut Down Irradiator
To Resume Irradiation Prior to ABORT, Restart Program

Note: All Irradiation Data Has Been Saved Prior to ABORT"

Shut down the Irradiator and clear the fault.

To restart the program type "Start"

3.9.1 DOOR

On the screen the error is displayed

"Door Opened During Irradiation"

This indicates that the door to the Irradiator was opened during Irradiation. This is not an error, but a stop is made to ensure safety of the operator. One can resume where the last dosimeter irradiated was completed.

3.9.2 ERROR AND RESUME

This appears if on resuming the last rack has been removed by the operator.

The following message is displayed

"Racks Have Been Removed, Cannot Resume"

4) ERROR HANDLING

If any of the following messages appear and cannot be cleared service is neccessary:

"Back of Magazine Light Barrier Faulty"
"Dosimeter Light Barrier Faulty"
"Dosimeter Up Limit Switch Faulty"
"Front of Magazine Light Barrier Faulty"
"Magazine Light Barrier Faulty"
"Rack Down Limit Switch Faulty"
"Rack Light Barrier Faulty"
"Magazine Returned Light Barrier Faulty"
"Dosimeter Light Barrier Faulty"

5) SYSTEM ERRORS

When thes messages are displayed

5.1 "The Disk being written to is faulty"

Change the Floppy Disk.

5.2 "The Disk drive door is open"

Close door by moving lever downwards.

5.3 "The Disk being written to, is write protected"

Remove write protect sticker.

5.4 "Unable to find data file"

The data requested is not on file. Either insert disk with file or type correct data file name.

6) DATA FILES

The Data Files created for irradiating dosimeters are stored with the Suffix .IRR

These can be viewed by exiting the program to DOS and typing

Dir a:/w

or by using the View mode in the Irradiator software.

This lists all the files

If one wants to delete a file type Del xxx .IRR where xxx is the file name.

To delete all previous data files type Del * .IRR

Williston Elin

TLD IRRADIATOR WE 2001 PC

Irradiation Input Data

Data Entered on 01-11-89 at 10:37:39

Number of Racks to Irradiate = 3

Data for Rack 1

Dosimeter 1			Time	10.5 Seconds
Dosimeter 2	to	Dosimeter 10	Time	25.0 Seconds
Dosimeter 11	to	Dosimeter 21	Time	5.2 Seconds
Dosimeter 22	to	Dosimeter 42	Time	19.0 Seconds
Dosimeter 43	to	Dosimeter 50	Time	23.5 Seconds

Data for Rack 2

Dosimeter 1	to	Dosimeter 7	Time	4.0 Seconds
Dosimeter 8	to	Dosimeter 23	Time	33.1 Seconds
Dosimeter 24			Time	17.1 Seconds
Dosimeter 25	to	Dosimeter 46	Time	7.2 Seconds
Dosimeter 47			Time	3.0 Seconds
Dosimeter 48	to	Dosimeter 50	Time	3.2 Seconds

Data for Rack 3

Dosimeter 1	to	Dosimeter 50	Time	4.5 Seconds

Data Save as TESTING

Data File Name: TESTING

Irradiation Performed on 01-11-89 at 10:40:30

Data for Rack 1

Dosimeter	1	in Slot	1	Irradiated for	10.5 Seconds
Dosimeter	2	in Slot	4	Irradiated for	25.0 Seconds
Dosimeter	3	in Slot	13	Irradiated for	5.2 Seconds
Dosimeter	4	in Slot	16	Irradiated for	5.2 Seconds
Dosimeter	5	in Slot	25	Irradiated for	19.0 Seconds
Dosimeter	6	in Slot	32	Irradiated for	19.0 Seconds
Dosimeter	7	in Slot	33	Irradiated for	19.0 Seconds
Dosimeter	8	in Slot	44	Irradiated for	23.5 Seconds
Dosimeter	9	in Slot	50	Irradiated for	23.5 Seconds

Data for Rack 2

Dosimeter	10	in Slot	1	Irradiated for	4.0 Seconds
Dosimeter	11	in Slot	2	Irradiated for	4.0 Seconds
Dosimeter	12	in Slot	3	Irradiated for	4.0 Seconds
Dosimeter	13	in Slot	18	Irradiated for	33.1 Seconds
Dosimeter	14	in Slot	24	Irradiated for	17.1 Seconds
Dosimeter	15	in Slot	29	Irradiated for	7.2 Seconds
Dosimeter	16	in Slot	46	Irradiated for	7.2 Seconds
Dosimeter	17	in Slot	47	Irradiated for	3.0 Seconds
Dosimeter	18	in Slot	49	Irradiated for	3.2 Seconds

Data for Rack 3

Dosimeter	19	in Slot	1	Irradiated for	4.5 Seconds
Dosimeter	20	in Slot	17	Irradiated for	4.5 Seconds
Dosimeter	21	in Slot	36	Irradiated for	4.5 Seconds
Dosimeter	22	in Slot	50	Irradiated for	4.5 Seconds

ASSEMBLY OF LEAD CASTLE AND LOADING OF SOURCE

1. Remove the lid of the irradiator and the steel plate seperating the lead castle from the rack. Leave the angle brackets so as not to have to set after loading of lead.

2. Locate no. 5 on the lead castle assembly drawing, (groves machined at base of lead). To load, move block carefully forward towards the dosimeter push-up assembly (aluminium bridge no. 19 containing brass moveable push-up rod) until it just seats. Push 8mm bolts through the holes in lead block.

3. Locate lead block no. 4 (block has groves machined at lower end). Move this block gently into position with flat end towards dosimeter push-up assembly 19. Make sure block locates on locating pins. Screw the two lower 8mm bolts with steel spacer 18 into lower lead ring at this stage. Load block 3,2 and 1 sequentially in the same manner. Screw 1 to lead block with 8mm bolts supplied.

4. Locate sleeve 8. Leave whole assembly mounted as is. Remove nylon stop and turn hand so that source holding screw is visable. Remove 1 m loading rod 21 from frame of instrument.

5. Place sleeve 8 into hole in lead castle 6 and place a spacer (eg. wooden block) under it so that the hole for loading source is visable. Load the source using your own manipulator with side that is not nurled facing aperture in cylinder. Screw holding screw 14 using tool 21 into cylinder (make sure not to apply to much pressure to source).

6. Take manipulator. Hold firmly and lift cylinder slightly, in order to be able to remove wooden block. Lower cylinder gently and completely into sleeve.

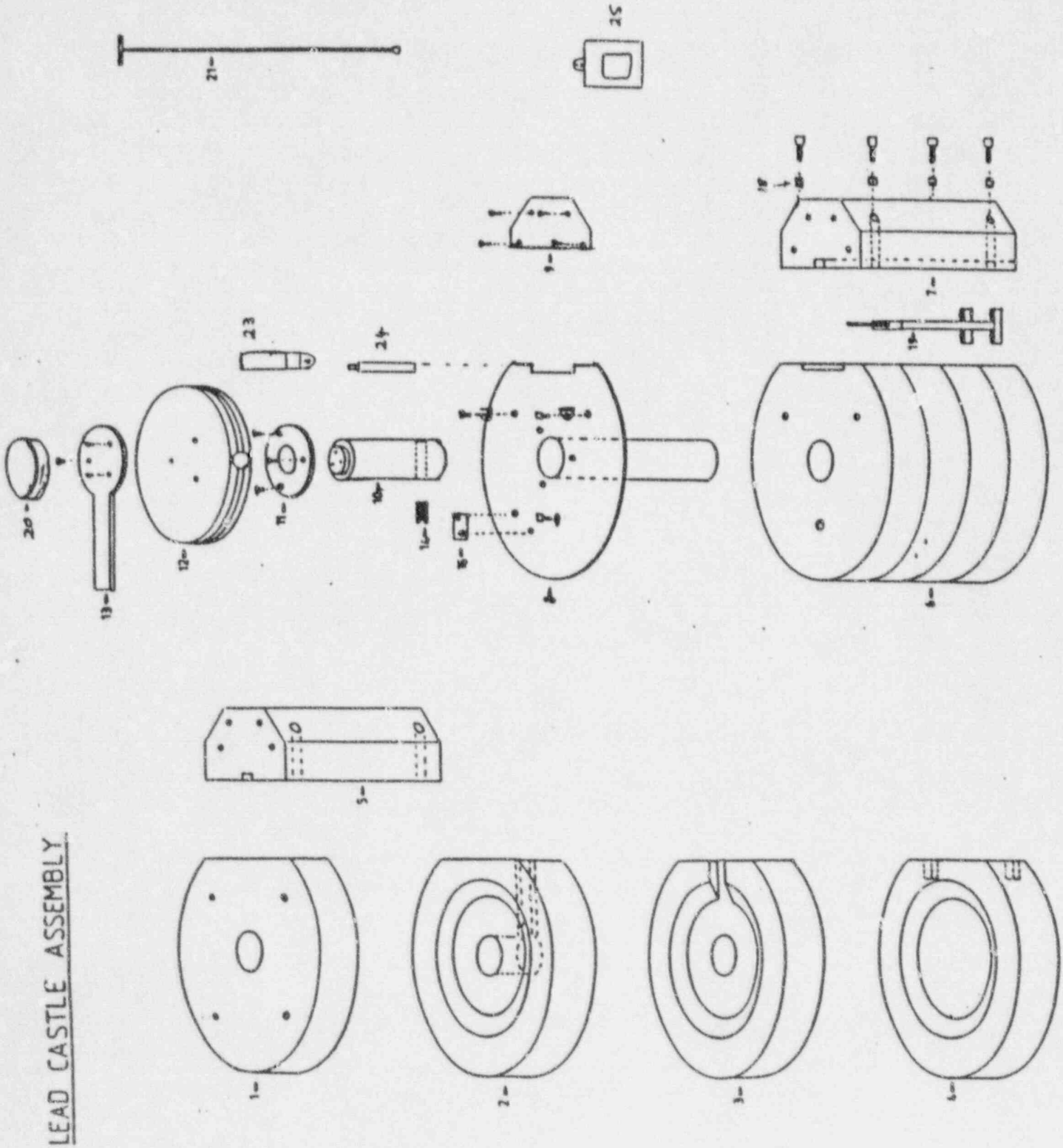
7. Screw sleeve 8 to lead.

8. Mount micro switch bracket to plate 8. Adjust the micro switch so that when handle is turned against the nylon stop the switch is activated.

9. Place filter 25 containing 3mm plexiglass into slot in lead castle.

10. Screw protecting cap 23 to steel plate 9 using 5mm screws supplied.

11. Place lead cap 20 on top of handle.



LEAD CASTLE ASSEMBLY

9) SWIPE TEST

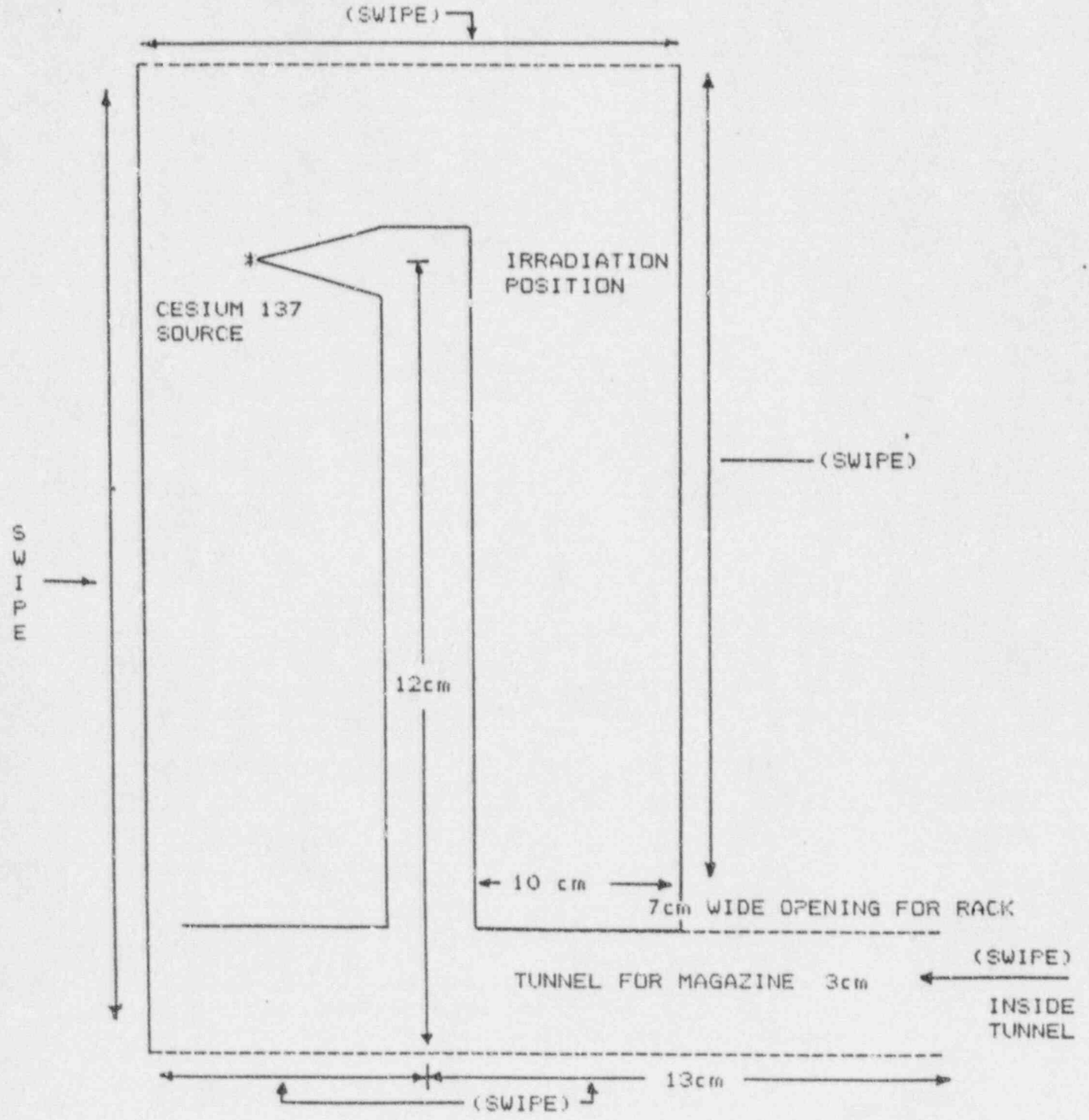


Figure 1. Diagram showing the path from the elevator chamber to the irradiation position.