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CATHODE LIFE TEST FACILITY USERS MANUAL OPERATING AND MEASUREMENT PROCEDURES

Atlantic Research Corporation

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Rome Air Development Center
Air Force Systems Command
Griffiss Air Force Base, NY 13441-5700

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13. ABSTRACT (Maximum 200 words)

This report presents all aspects of the operating procedures for the Cathode Life Test Laboratory operated by RADC/OCTP in Bldg 112 at Griffiss AFB NY 13441-5700.

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1.0 Introduction

This report is designed to be a users manual describing the operating and measurement procedures required to conduct life test experiments on thermionic cathodes, within the RADC Cathode Life Test Facility.

1.1 Facility Description

The Cathode Life Test Facility located in building 112, Cell 8, at Griffiss Air Force Base is designed for determining the degradation characteristics of cathode emitters. Through the use of this facility, Rome Air Development Center conducts life test measurements on various types of thermionic cathodes [1]. The facility is presently equipped with 40 power supplies, 38 of which were manufactured by Cober Electronics and 2 which were designed by RADC. The power supply specifications [2] are presented in Table 1.1. A Liebert Corporation A/C Aircooled R-22 unit is capable of maintaining constant temperature and relative humidity independent of weather conditions. Measurement and Calibration Equipment includes:

1) 2-Pyro Micro-Optical disappearing filament Pyrometers, Model 95-C33200

2) 2-Two Color Optical Pyrometers, Ircon Model R-14C05-0-2-0-00-0/000

3) Rotek AC/DC Precision Calibrator, Model 3910

4) Test load Vehicle Simulator

1.2 Facility safety

Lethal voltages exist in the Cathode life test facility. The vehicle power supplies operate at several thousand volts and extreme care should be taken whenever working inside the cabinets.

When high voltage is exposed in the Lab, two (2) or more persons shall be present both of which are knowledgeable in safety procedures. Exposed high voltage exists whenever the rear door on a test supply is open or when equipment drawers are pulled out while the power supply is plugged in. When the VAC-ION power has been removed and, if the high voltage supply has been fully discharged with a shorting stick, work may proceed with only a single person present.

A High Voltage warning sign should be placed conspicuously in front of the facility so that it can be seen by anyone entering. The facility should always be locked when unoccupied and a safety board equipped with necessary first-aid equipment is located directly outside the front doorway.

1.3 Facility Maintenance

Daily inspection of the facility and its operating equipment is required. Maintenance are divided into two categories. Laboratory maintenance consists of checking the room environment and involves examination of the lights, AC power, and heating/cooling apparatus. Failure of any of these, requires immediate notification of the facility manager. Equipment maintenance requires checking the vehicle power supplies and includes the current and voltage meters, elapsed time indicators, vehicle cooling units and the VAC-ION pumps. Failure of any of these items requires immediate repair or replacement. Anomalies which are encountered during the maintenance checks must be documented in the daily log book and reported to the facility manager.

1.4 Facility Power-Down

Throughout the process of life testing the cathode vehicles, it is inevitable that the facility will need to be systematically shut down for short periods of time. Planned down periods are typically a result of thunderstorm activity or prime power outage. When it is required to power-down the facility, the procedures outlined in Table 1.2 should be followed.

1.5 Facility Power-Up

In order to safely and effectively bring the cathode test vehicles back on-line after having been turned off, a systematic procedure was developed and documented. The procedure to follow for powering up the test vehicles is outlined in Table 1.3.

Table 1.1

Power Supply Specifications

Input Power

115 VAC $\pm$ 10% 60HZ

Cathode Supply

Zero to 6000 VDC negative @ 20 ma (min.)
1% regulation

Collector Supply

Fixed ratio (0.3 + 10%) of 6 KV, with respect to ground.
Zero to 2000 VDC positive with respect to the cathode.
240 ma (min.), 5% regulation

Filament Supply

Zero to 10 VAC, 4A, 1% regulation isolated to float at cathode potential

Table 1.2

Facility Power-Down Procedure

1. Turn off the T.U.T. high voltage (Cober model 3399 and RADC supplies only).

2. Turn off the cathode/collector high voltage (for Cober supply model 3260 the cathode and collector high voltages are separate push buttons. First turn off the cathode HV and then the collector HV).

3. Turn off the ion blocking power supply (Cober supply model 3260 only).

4. Turn off the filament power, then turn the filament voltage adjustment dials all the way off (counterclockwise).

5. Turn the system power off.

6. Shut off the main input power breaker on the front panel of the supply. It is not necessary to shut off the supplies at the main breaker.

7. Shut off the Varian vac-ion pump control units that are connected to the vehicles in the Cober model 3399 and RADC power supplies.

8. DO NOT touch the cathode/collector adjustment dials. It is more helpful during power up if they are left at the same setting prior to power down.

9. If the lab will be down longer than 2 days, unplug the fan near the ceiling, turn off the floor fan in the rear of the lab, and turn off the air conditioner using the "STOP" button located in the upper right hand corner of the front panel.

10. Log shut down and the reason in the facility log book located on the front desk (i.e. Shut down the lab due to work being done on the load center which will cause intermittent loss of power during the next week).

Table 1.3

Facility Power-Up Procedure

1. Ensure the air conditioner in the lab is functioning and both fans are running prior to energizing any equipment.

2. Turn on the Varian vac-ion pump control units connected to the vehicles in the Cober model 3399 and RADC power supplies.

3. Turn on the circuit breakers on all the supplies that contain test vehicles and turn on the system power. do this to all supplies before proceeding to the next step. Ensure all blowers are working and the front panel lights are on. Pressing the OFF/RESET button should clear the alarms. If it does not there may be a problem with the supply.

4. Turn on the filament power and slowly turn up the filament voltage so the filament current does not exceed more than twice the life test level and possibly cause damage to the vehicle. As a general rule of thumb, do not exceed 2.0 amps on the Siemens MK vehicles and 2.5 amps on the remaining vehicles under test. Allow about 3-5 minutes for the cathode to heat up and the current to drop before turning up the filament voltage again. Continue this for each vehicle and by the time all the vehicles have had the filament power turned on and the voltage initially adjusted, the first vehicles will have settled down and are ready to be readjusted.

5. Continue the filament voltage adjustment as per step (3) until the life test filament voltage, which is noted on the vehicle information card (VIC) mounted on the vehicle box, is achieved. Then wait about 5 minutes for the filament current to stabilize.

6. Enable the cathode/collector voltage. On the older Cober power supplies (model 3260) the cathode and collector voltages are separate buttons. First enable the collector voltage and then the cathode voltage. The adjustment knobs are usually preset to the correct values from when either the supply was shut off or when power was lost. If the values are off, adjust the cathode voltage to the value specified by the VIC mounted on the vehicle box.

7. After ensuring the cathode and collector voltages have come up, enable the T.U.T. high voltage to apply the voltages to the test vehicle. If all is working properly the cathode and collector current should come up to normal levels (near 100%) and the body current should not trip off the high voltage.

8. Turn on the Ion blocking supply (Cober supply model 3260 only).

Table 1.3 (Concluded)

9. Readjust the filament voltage if necessary. If the cathode and collector voltages had to be reset at power up it is best they be checked and adjusted every couple of hours during the first day. If the voltage adjustment knobs were preset at power up do not adjust them the first day. The power supply and test vehicle need time to warm up and stabilize. The voltages can, and often will be unstable for the first 24 hours.

10. After 1 or 2 hours the filament voltages will require further adjustment.

11. At the end of the work day the power supply voltages should be checked again and readjusted if necessary.

12. The next day after readings are taken the voltages should be adjusted if needed.

13. Then on a daily basis all voltages should be checked and adjusted if needed, after the daily readings have been taken.

Table 2.1

Procedure for Placing a New Vehicle On-Line

1) Calibrate the power supply while connected to the vehicle simulator.

2) Install the Cathode test vehicle according to the wiring chart below, unless otherwise noted.

White Wire - Cathode

Yellow Wire - Heater

Red Wire - Collector

3) Turn the filament voltage down to 0.0V.

4) Energize the VAC-ION pump and cooling fan

4a) If the internal pressure exceeds '5' on the vacuum scale inform the facility manager. If not proceed to Step 5.

4b) Figure 2-1 graphs the current vs. pressure relationship of the VAC-ION pumps. The Cathode facility uses the 2 l/s pump on the test vehicles.

5) Allow the vehicle to stabilize at a vacuum of less than 0.5.

5a) If a satisfactory vacuum is not obtained within one hour, notify the facility manager.

6) Raise the filament voltage to approximately 1 volt. A surge in vehicle pressure should occur, if no surge is observed, inform the facility manager. If the surge exceeds a '5' on the vacuum scale, reduce the filament voltage.

7) Slowly increase the filament voltage until 1050 deg. C (True) is obtained. If the temperature cannot be reached, inform the facility manager.

8) Energize the Cathode and Collector voltage. Increase the voltage until 100% loading is obtained.

i.e. 100 ma for Current densities of $2A/cm^2$

200 ma for Current densities of $4A/cm^2$

9) Allow the vehicle to operate under these conditions for 24 hours. [The vacuum should read less than one on the six scale.]

10) Perform the initial Miram curve measurements starting at 1100 deg. C.

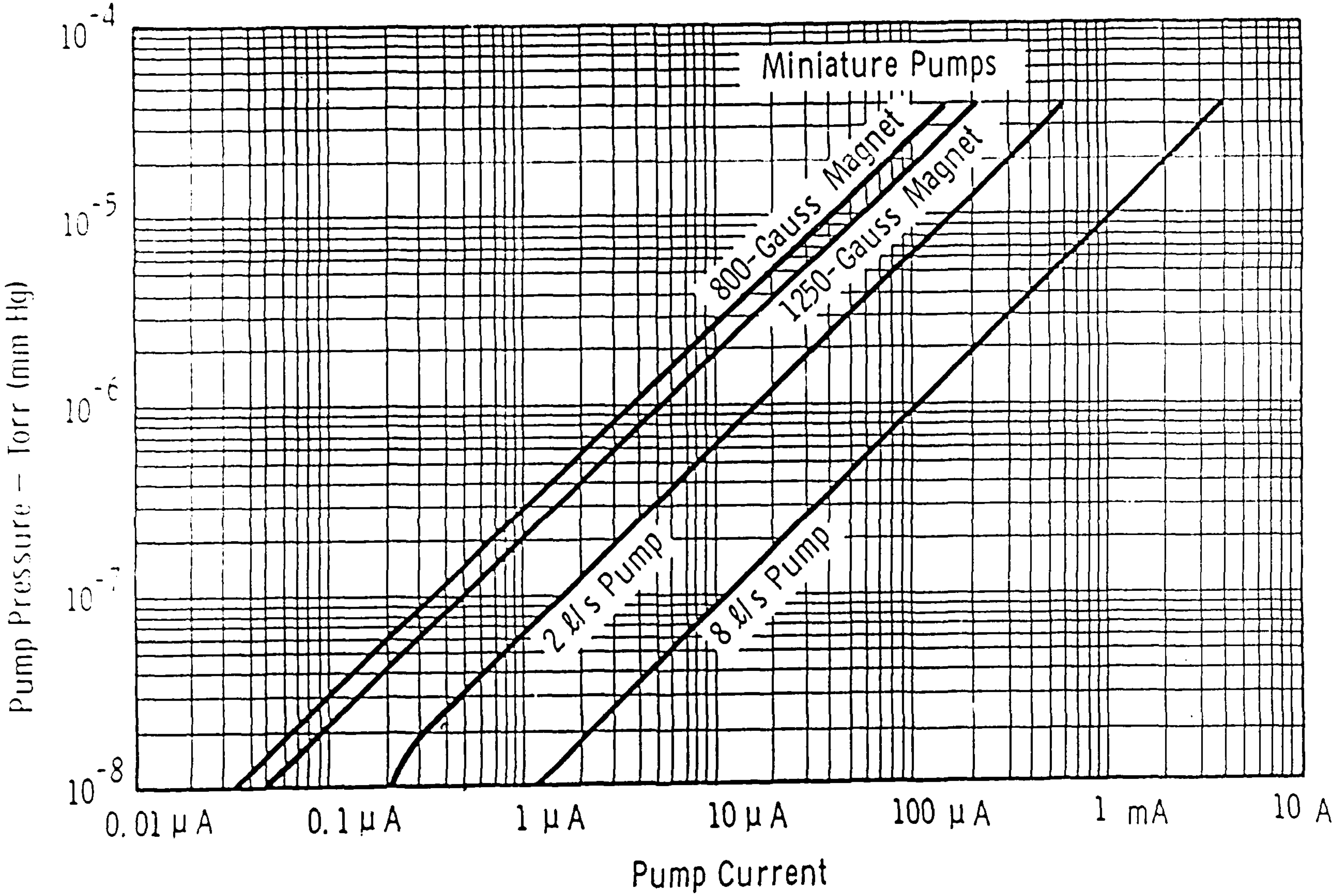


Figure 2-1 VAC-ION Current vs Pressure

Table 2.2

POWER SUPPLY COMPONENT FAILURE ANALYSIS

COMPONENT	MEAN TIME BET. FAILURES	HOURS ON EXISTING COMPONENTS* 0 - 20K	20K - 30K	30K - 40K	40K - 50K	50K +	SPARES AVAILABLE	EST. UNIT COST
T3** Cathode power transformer	32,679 hrs. (3.73 yrs.)	5	6	3	10	5	7	$5[illegible]
ETM Elapsed time meter	21,616 hrs. (2.47 yrs.)	2	10	8	14	2	19	$41
T6 & T7 Coll. & Cath. current sensors	42,270 hrs. (4.83 yrs.)	16	11	17	22	6	3	$277
Body Current Meter	39,231 hrs. (4.48 yrs.)	3	7	9	13	6	16	$270
P/S 2 Acopian +28v supply	43,253 hrs. (4.93 yrs.)	3	7	8	14	4	2	$95
P/S 1*** Acopian +/-15v supply	27,678 hrs.	1	7	8	15	5	4	$75
Digital Volt. / Curr. meters	33,107 hrs. (3.78 yrs.)	2	7	8	15	6	143	$175

* Hours computed through 12 Jan. 1990.
** 9 transformers were replaced before Jan. 1988 when life tracking of P/S components began.
*** Only one failure ever recorded.

2.0 Vehicle Preparation

2.1 Initial

Upon receipt of a test vehicle, the package should be opened and inspected for physical damage. Physical damage includes dents, damaged or broken leads and cracked or broken ceramics. If any damage is observed the facility manager should be notified. If there is no noticeable damage, the vehicle may be installed in the appropriate power supply test station, and energized. The procedure for placing a new cathode test vehicle on-line is summarized in Table 2.1.

2.2 Rotek Calibration

The Rotek calibrator is used for calibration and alignment of test vehicle power supplies, and should be allowed to warm-up and stabilize prior to use. There are four output signals from the Rotek that are required for calibration of a power supply.

The first is an output of negative 1000 VAC for calibration of the cathode and collector voltage meters. Set the "range" selector to 1000 and rotate the range dials to read 10-0-0. The next output delivers 100 ma and is used to calibrate the cathode and collector current meters. Depress the "AMPS" button and set the range to 100, leaving the range dials at 10-0-0.

For calibration of the filament voltage meter, a 5 VAC output is required. Set the selector switch to "HZ x 10", and the frequency dial to "6". Set the "range" selector to "10", the range dials to "5-0-0" and the units to "VOLTS." The fourth output is required to calibrate the filament current meter. Retain the selector switch and frequency dial settings to "HZ x 10" and "6" respectively. Set the units to "AMPS" and the range selector to 1000. Change the range dials to read "10-0-0." The Rotek Calibrator will now output a 1 ampere 60 cycle signal.

2.3 Power Supplies

There are a total of forty operational test vehicle power supplies within the facility. Thirty Eight were manufactured by Cober Electronics and two were designed by RADC. There are two different models of the Cober supplies. Twelve are model #3260, and twenty six are model #3390. Each power supply requires calibration and each power supply model involves a different calibration procedure.

2.3.1 Power Supply Component Failure Analysis

A study was conducted to determine the operating life expectancy of the power supplies and their components. The results of this study is summarized in Table 2.2.

2.4 Calibration Procedure

Power supply calibration is required. There are three instances when it is necessary to calibrate the power supplies.

1) 24 hours prior to placing a new test vehicle on-line

2) 24 hours prior to performing MIRAM curve measurements.

3) Anytime the integrity of the supply is in question.

When calibrating a power supply with a vehicle installed, it is recommended to minimize downtime as much as possible to prevent the cathode from cooling significantly, thus causing errors in the next day measurements. A life test condition sheet is required to be annotated during each calibration. A life test condition sheet is shown in Table 2.3. For safety purposes, two or more persons should be present when calibrating the power supplies.

Table 2.3

LIFE TEST CONDITIONS

TEST VEHICLE TYPE __________ P/S __________ DATE __________

MFR __________ S/N __________ RECORDER __________

ETM __________ PREVIOUS ETM __________

ΔETM __________

NOMINAL CATHODE LOADING __________ AMP(S)/CM^2

CATHODE VOLTAGE __________ V

CATHODE TEMP __________ °C.

INITIAL CATHODE CURRENT __________ MILLIAMPS

PRESENT CATHODE CURRENT __________ MILLIAMPS

PERCENT OF INITIAL __________ %

FILAMENT POWER = __________ V x __________ A = __________ WATTS

COLLECTOR VOLTAGE __________ V

COLLECTOR + BODY CURRENT = __________ + __________ = __________ mAMPS

VACION CURRENT (VACUUM) __________

CALIBRATION

DATE __________ ETM __________

	VOLTAGE		CURRENT	
CATHODE-------	READS ______	ADJ TO ______	READS ______	ADJ TO ______
	CAL ______		CAL ______	
FILAMENT------	READS ______	ADJ TO ______	READS ______	ADJ TO ______
	CAL ______		CAL ______	
COLLECTOR	READS ______	ADJ TO ______	READS ______	ADJ TO ______
	CAL ______		CAL ______	

2.4.1 Cober Model 3399

Open the power supply drawer far enough to be able to access the adjustment potentiometers on both metering circuit cards. Set the Rotek calibrator to output -1000 VAC. Ground the high voltage meter to the Rotek first, then connect the positive lead to the positive output. Depress the"operate" switch on the Rotek and .djust the high voltage meter to read -1000 V. To calibrate the cathode voltage meter, ground the meter to the chassis of the power supply and connect the high voltage meters' positive probe to either lead (82) of relay K21 which is located directly above the main power transformer T3. The power supply will be slightly loaded therefore it is recommended to proceed as quickly as safety regulations dictate. Adjust potentiometer R24, located on metering circuit card "A" such that the cathode voltage meter reads the same as the high voltage meter. To calibrate the collector voltage meter, connect the positive probe of the high voltage meter to wire lead 70 located on top of the supply on the output of C3. Adjust potentiometer R26 on metering circuit card "A" such that the collector voltage meter reads the same as the high voltage meter.

To calibrate the cathode and collector current meters, the Rotek must be set for an output of 100 ma as described in section 2.2. On each power supply, there is a dual soldered terminal strip that is left of the metering circuit card. Connected to this strip is a wire that passes through both the cathode and collector current sensors. This wire is required to calibrate the current meters.

NOTE: To calibrate the cathode and collector current meters, the T.U.T. high voltage must be turned off, thus disabling the current and voltage to the test vehicle.

With the Rotek in standby, connect the leads to the terminal strip then enable the current output. The power supply current meters should read 100.0 ma. If the meters read zero, then the leads are reversed and need to interchanged. The adjustment potentiometers are located on metering circuit card "B". R10 adjusts the cathode current meter and R9 adjusts the collector current meter.

To adjust the filament voltage meter, the output of the Rotek must be set to 5.0 VAC. Using a precision multimeter, verify that the output is 5.0 VAC. Ensure that the cathode and collector high voltage is disabled. Connect the negative lead of the multimeter to the Heater/Cathode jack output on the back panel of the power supply and the positive lead of the multimeter to the heater jack. Using the coarse and fine adjustment potentiometers located on the front panel of the power supply, adjust the filament voltage until the multimeter reads 5.0 VAC. Using potentiometer R4 located on metering circuit card "A", adjust until the filament voltage meter reads 5.00 V.

The final adjustment is the filament current. Set the Rotek to output 1000 ma (1 amp) at 60 cycles. Disable the filament voltage. Feed a wire through the filament current sensor (T10) and connect each end to the Rotek leads, ensuring not to short the leads to the power supply chassis. Adjust potentiometer R5 on metering circuit card "A" until the filament current meter read 1.00 ampere.

The calibration is complete. Bring the test vehicle back up tc life test conditions in preparation for the next days Miram plot measurements.

2.4.2 Cober Model 3260

The Cober model 3260 power supplies contain integrated built-in ion blocking supplies. Located on the right hand side, interior to the main power supply door is a terminal strip labeled TB1. This terminal strip shown in figure 2-2 contains the majority of the connection test points required for calibration.

To calibrate the cathode voltage meter, set the Rotek to output -1000 VAC, and connect the ground lead to the chassis. Attach the test lead to terminal number 12 on TB1. Located on a small non-designated circuit board at the top of the power supply are two potentiometers. The left one is R24 and the right one is R26. Adjust R24 until the cathode voltage meter reads the same as the high voltage meter. The collector voltage meter is adjusted using R26 with the Rotek test lead connected to terminal 9 on TB1.

To calibrate the cathode and collector current meters, the cathode and collector high voltage must be disabled. With the Rotek set to output 100 ma, connect the test leads to terminals 1 and 2 on TB1. With the Rotek energized, the current meters should indicate a signal. If they do not, then the leads are reversed. The adjustment potentiometers for the cathode and collector current meters are R10 and R9 respectively. These are located on the circuit board which is mounted above and to the right of TB1. These potentiometers should be adjusted such that each meter reads 100.0 ma.

The filament voltage is adjusted using a precision multimeter and the Rotek set to output 5 VAC. Connect the multimeter to the Rotek and note the reading. Then connect the positive and negative multimeter leads to terminals 12 and 14, respectively, on TB1. Using front panel controls, adjust the filament voltage such that the multimeter deflection duplicates the reading when connected to the Rotek. Adjust potentiometer R4 until the filament voltage meter indicates 5.0 volts. R4 is located on the same circuit board as R9 and R10.

To calibrate the filament current, disable the filament voltage and feed a wire through the filament current sensor T4. Set the Rotek to output 1000 ma (1 amp) and connect the leads to each end of the wire. Adjust potentiometer R5, which is located next to R4 such that the filament current meter reads 1.0 amperes.

The calibration is complete. Bring the test vehicle backup to life test conditions in preparation for the next days Miram plot measurements.

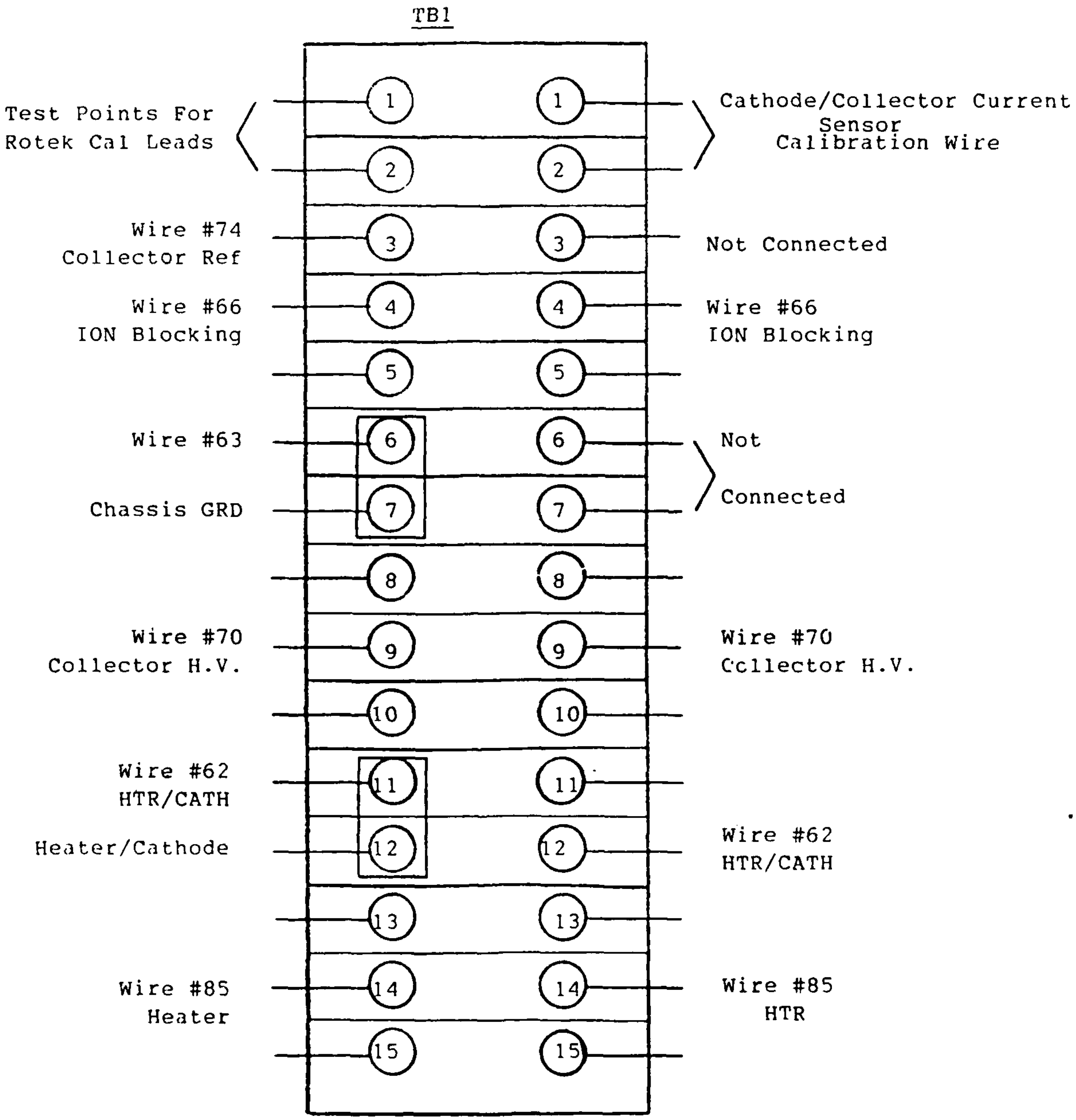
2.4.3 RADC Model HVPS-1

The only adjustments that can be accomplished on the RADC power supplies are the cathode and collector voltages. There are no provisions which permit adjustment of the other power supply parameters.

With the supply energized and connected to a load, ground the high voltage meter to the chassis and connect the test lead to the cathode voltage output. Adjust potentiometer R24 until the power supply meter reading and the high voltage meter reading are identical.

To calibrate the collector voltage meter, connect the high voltage meter test lead to the collector voltage output. Adjust potentiometer R26 until the power supply meter reading and the high voltage meter reading are identical.

Potentiometers R24 and R26 are located on the top right hand side of the power supply section. The cathode and collector high voltage outputs are located on the rear panel of the supply and are accessible from the front.



Fijure 2-2 P/S 3260 Test Point Terminal

2.5 Vehicle Simulator

The Vehicle Simulator emulates the loading characteristics, placed on the power supply, of a thermionic cathode. It is primarily used for power supply troubleshooting and calibration verification while operating under actual loading conditions. The schematic diagram of the simulator is shown in figure 2-3. It is comprised of a simple network of high wattage ceramic resistors. The connections to the simulator are the 'Body', 'Cathode', 'Collector', and the 'Heater'. The current/voltage relationships are given below and can be used to verify the power supply calibration and meter/circuit linearity under actual operating conditions.

$$\text{Body Current} = \frac{\text{Cathode Voltage}}{251\text{ K}}$$

$$\text{Collector Current} = \frac{\text{Cathode Voltage-Collector Voltage}}{7.46\text{K}}$$

$$\text{Cathode Current} = \text{Collector Current} + \text{Body Current}$$

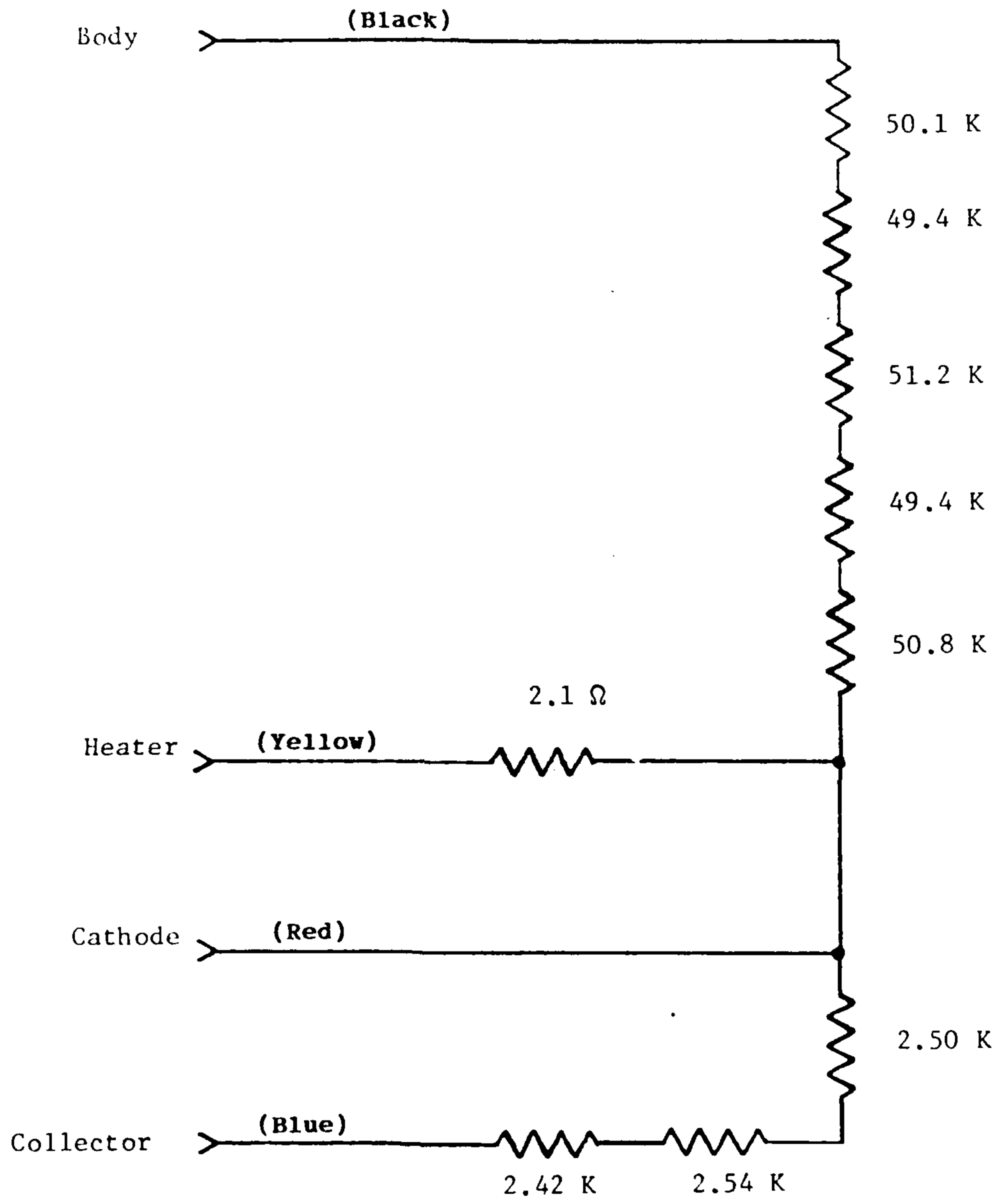


Figure 2-3 Vehicle Simulator Schematic

3.0 Measurement Procedure

3.1 Meter Readings

Daily readings of each meter on all power supplies which contain a test vehicle will be accomplished. The readings will be transferred to the daily meter log shown in figure 3-1. The daily meter logs are designed to contain one calendar months worth of life test parameter information. Life test operating voltage data from the filament, cathode, collector circuits will be recorded as well as current consumption of the three plus the body current will be annotated. Elapsed time meter readings are also required and space is provided to document any unusual or downtime occurrences. The Ion-Blocking voltage and current readings are only applicable to the Cober Model 3260 power supplies. Daily meter log books are located on top of each power supply cabinet. The unit number is the equipment accountability number where 'A' refers to the top power supply and 'B' refers to the bottom power supply. The daily readings are performed to accomplish two objectives. The first is to keep continuous records of the test vehicle and power supply operating conditions. Secondly, the daily readings ensure that failure of the power supply or test vehicle is quickly determined and corrected.

3.2 Operating Temperature

The life test operating temperature of a thermionic cathode is determined in one of two ways. The first is that the manufacturer specifies the operating temperature. The second is to compute the operating temperature based upon initial Miram curve data. (Out of 35 vehicles currently under test; 5 vehicles had operating temperatures specified, the remaining vehicles operating temperatures were computed.) To compute the operating temperature of a test vehicle, initial Miram curve measurement data is required. Upon plotting the data, straight line curve fits are established for both the temperature limited region and the space charge region. The intersection of these two lines is defined as the Kneepoint of the curve and the life test operating temperature is typically chosen to be 50 degrees centigrade above the Kneepoint. This procedure is illustrated graphically in figure 3-2.

3.2.1 Kneecalc

A computer program was developed which computes the vehicle life test operating temperature based upon the initial Miram curve data. The coding uses a least-squares method, along the temperature limited region and the space charged region, in an iterative manner to obtain the best straight line fit to establish the kneepoint of the curve. Upon determination of the kneepoint it is a simple matter to compute the operating temperature. In instances where the operating temperature is not specified by the manufacturers, the operating temperature is typically chosen to be 50 degrees centigrade above the Kneepoint. Fifty degrees above the knee is not always a constant and the facility manager should be contacted for the correct offset. A hard copy listing of the program "KNEECALC" is given in Table 3.1. The program is written in DOS basic and is resident on the facilities personal computer. It permits the creation of original data files for new test vehicles and allows existing files to be read to recompute the operating temperature.

CATHODE LIFE TEST DAILY METER LOG

UNIT - NUMBER: MONTH:

CATHODE TYPE: YEAR:

DAY	TIME	FILAMENT VOLTAGE	FILAMENT CURRENT	CATHODE VOLTAGE	CATHODE CURRENT	COLLECTOR VOLTAGE	COLLECTOR CURRENT	BODY CURRENT	E T M	ION BLOCK CURRENT	ION BLOCK VOLTAGE	COMMENTS	INIT
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
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Figure 3-1 Daily Meter Log

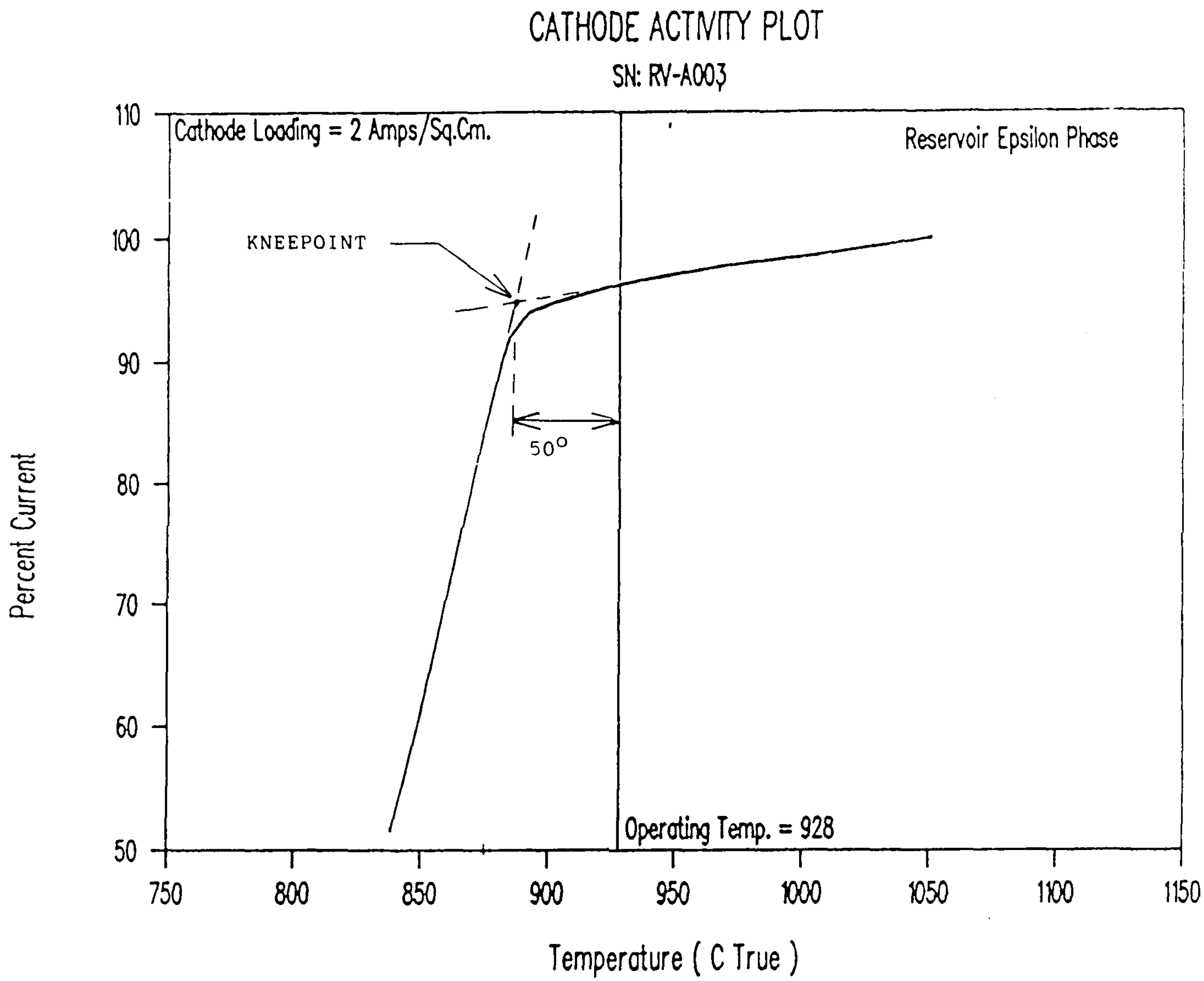


Figure 3-[illegible]. Operating Temperature Solution

Table 3.1 KNEECALC

```
10 'THIS PROGRAM WILL CALCULATE THE LEAST-SQUARES LINES FOR THE TEMPERATURE
20 'LIMITED REGION AND THE SPACE CHARGE LIMITED REGION OF A MIRAM PLOT.
30 'THE PROGRAM WILL THEN CALCULATE THE INTERSECTION POINT OF THESE TWO
40 'LINES TO GET THE KNEE OF THE MIRAM PLOT. THE PROGRAM WILL ALSO CALCULATE
50 'THE OPERATING TEMPERATURE OF THE CATHODE.
60 DIM XXX(100),YYY(100),XTL(100),YTL(100),YPRIMESC(5000),YPRIMETL(5000),DELTA(1
00)
70 INPUT"DO YOU WISH TO CREATE OR READ (C OR R) A DATA FILE? ",A$
80 IF A$<> "C" AND A$<> "R" THEN 70
90 IF A$="C" THEN 100 ELSE 200
100 INPUT"WHAT DO YOU WANT TO NAME THE FILE? ",N$
110 OPEN "O",#1,"A:"+N$
120 INPUT"HOW MANY DATA POINTS ARE TO BE ENTERED? ",NSC
130 WRITE#1,NSC
140 FOR I = 1 TO NSC
150 INPUT"ENTER TEMPERATURE,PERCENT CURRENT(DESCENDING ORDER)",XXX(I),YYY(I)
160 WRITE#1,XXX(I),YYY(I)
170 NEXT I
180 CLOSE #1
190 IF A$="R" THEN 200 ELSE 360
200 INPUT"WHICH FILE DO YOU WANT TO READ? ",N$
210 OPEN "I",#2,"A:"+N$
220 INPUT#2,NSC
230 FOR I = 1 TO NSC
240 INPUT#2,XXX(I),YYY(I)
250 NEXT I
260 CLOSE#2
270 INPUT "DO YOU WISH TO VIEW THE DATA OR COMPUTE THE KNEE(V or K)?",D$
280 IF D$<>"V" AND D$<>"K" THEN 270
290 IF D$="K" THEN 360
300 PRINT CHR$(12)
310 PRINT " PT.            TEMP.          %FSCL"
311 PRINT
320 FOR I=1 TO NSC
330 PRINT I,XXX(I),YYY(I)
340 NEXT I
350 GOTO 1380
360 WIN = .5
370 'THE VARIABLE WIN IS USED FOR REDUCING THE DEVIATIONS BETWEEN THE
380 'MEASURED DATA AND THE LEAST SQUARE PREDICTION.
390 FACTOR = 50
400 'THE VARIABLE FACTOR IS THE NUMBER OF DEGREES CENTIGRADE ADDED TO
410 'TO THE KNEE TEMPERATURE TO OBTAIN THE OPERATING TEMPERATURE.
420 INTCPT=.25
430 'THE VARIABLE INTCPT IS USED TO DETERMINE HOW CLOSE THE LEAST SQUARES
440 PRINT CHR$(12)
450 BEEP
460 PRINT "...............WORKING.............PLEASE STAND BY"
470 'LINES WILL INTERSECT.
480 NTL=NSC
490 NNN = INT(NSC/2)
500 'TEMP LIMITED CALC PART-----------------------------------
510 '
520 SUMXXX=0
530 SUMYYY=0
540 SUMXXX2=0
550 SUMXYSC=0
560 FOR I = 1 TO NNN
570 SUMXXX = SUMXXX+XXX(I)
580 SUMYYY = SUMYYY+YYY(I)
```

Table 3.1 KNEELCALC (continued)

```
59Ø XXX2 = XXX(I)*XXX(I)
6ØØ SUMXXX2 = XXX2+SUMXXX2
61Ø XYSC=XXX(I)*YYY(I)
62Ø SUMXYSC = SUMXYSC + XYSC
63Ø NEXT I
64Ø DENOMSC = ((NSC/2)*SUMXXX2)-(SUMXXX*SUMXXX)
65Ø NUMASC = (SUMYYY*SUMXXX2)-(SUMXXX*SUMXYSC)
66Ø NUMBSC = ((NSC/2)*SUMXYSC)-(SUMXXX*SUMYYY)
67Ø ASC1=NUMASC/DENOMSC
68Ø BSC = NUMBSC/DENOMSC
69Ø '
7ØØ XXXMAX=XXX(1)
71Ø FOR I = 2 TO NSC
72Ø IF XXX(I) > XXXMAX THEN XXXMAX = XXX(I)
73Ø NEXT I
74Ø '
75Ø FOR TEMP=1 TO INT(NSC/2)
76Ø YPRIMESC(TEMP)=ASC1+(BSC*XXX(TEMP))
77Ø DELTA(TEMP)=YYY(TEMP)-YPRIMESC(TEMP)
78Ø IF DELTA(TEMP) < WIN THEN 79Ø ELSE 8ØØ
79Ø IF DELTA(TEMP) > -WIN THEN 82Ø ELSE 8ØØ
8ØØ NSC=NSC-1
81Ø GOTO 49Ø
82Ø NEXT TEMP
83Ø '--------SPACE CHARGE LIMITED PART------------------------------------
84Ø SUMXXX=Ø
85Ø SUMYYY=Ø
86Ø SUMXXX2=Ø
87Ø SUMXYTL=Ø
88Ø FOR I=NNN TO NTL
89Ø SUMXXX=SUMXXX+XXX(I)
9ØØ SUMYYY=SUMYYY+YYY(I)
91Ø XXX2=XXX(I)*XXX(I)
92Ø SUMXXX2=SUMXXX2+XXX2
93Ø XYTL = XXX(I)*YYY(I)
94Ø SUMXYTL=SUMXYTL+XYTL
95Ø NEXT I
96Ø '
97Ø DENOMTL=(((NTL+1)-NNN)*SUMXXX2)-(SUMXXX*SUMXXX)
98Ø NUMATL=(SUMYYY*SUMXXX2)-(SUMXXX*SUMXYTL)
99Ø NUMBTL=(((NTL+1)-NNN)*SUMXYTL)-(SUMXXX*SUMYYY)
1ØØØ ATL = NUMATL/DENOMTL
1Ø1Ø BTL = NUMBTL/DENOMTL
1Ø2Ø FOR TEMP=NNN TO NTL
1Ø3Ø YPRIMETL(TEMP)=ATL +(BTL*XXX(TEMP))
1Ø4Ø DELTA(TEMP)=YYY(TEMP)-YPRIMETL(TEMP)
1Ø5Ø IF DELTA(TEMP) <WIN THEN 1Ø6Ø ELSE 1Ø7Ø
1Ø6Ø IF DELTA(TEMP) > -WIN THEN 1Ø9Ø ELSE 1Ø7Ø
1Ø7Ø NNN=NNN+1
1Ø8Ø GOTO 84Ø
1Ø7Ø NEXT TEMP
11ØØ '
111Ø '------THIS THE INTERCEPT CALCULATION PART-----------------------------
112Ø '
113Ø I=Ø
114Ø CH =Ø
115Ø CLR=Ø
116Ø FOR TEMP= Ø TO XXXMAX STEP .5
117Ø I=I+1
118Ø YPRIMESC(I)=ASC1+(BSC*TEMP)
```

Table 3.1 KNEECALC (concluded)

```
1190 YPRIMETL(I)=ATL +(BTL*TEMP)
1200 '
1210 '
1220 IF YPRIMESC(I) >YPRIMETL(I)-INTCPT THEN 1230 ELSE 1330
1230 IF YPRIMESC(I) <YPRIMETL(I)+INTCPT THEN 1240 ELSE 1330
1240 CLR=CLR+1
1250 BEEP
1260 IF CLR=1 THEN 1270 ELSE 1280
1270  PRINT CHR$(12)
1280 PRINT"KNEE TEMP= " TEMP
1290 PRINT"OP TEMP= " TEMP+FACTOR
1300 PRINT
1310 BEEP
1320 CK=1
1330 NEXT TEMP
1340 IF CK=0 THEN 1350 ELSE 1380
1350 PRINT CHR$(12)
1360 PRINT "USING THE DATA STORED IN THE FILE NAMED ";N$
1370 PRINT "NO KNEE INTERCEPT IS POSSIBLE WITH THE CURRENT VALUE SET FOR THE VAR
IABLE       <INTCPT>.    SUGGEST RELAXING THE TOLERANCE AND RECOMPUTING."
1380 END
```

Observe lines 360, 390 and 420 which contain the program variables WIN, FACTOR, and INTCPT respectively. The WIN variable is used to reduce or minimize the deviations between the measured data and the least-squares prediction. The variable is used during the iteration process when determining which data points are in the temperature limited region, the space charged region, or in the knee of the curve. The variable factor is the number of degrees centigrade added to the kneepoint temperature to obtain the operating temperature. The variable INTCPT is a window used to specify how close the least squares approximation lines will intersect at the kneepoint. The intersection is tested at 0.5 degree intervals therefore the INTCPT window is set to ± 0.25 degrees. Testing the intersect with finer temperature resolution, decreases the size of the window.

3.3 Miram Plots

A Miram or roll-off plot, shown in figure 3-3, is the fundamental basis for determining the life expectancy, of a thermionic cathode. Miram plot measurements are conducted regularly throughout the life test of the vehicle. The first measurement is conducted within one week after the vehicle is initially put on line. The second measurement is conducted after the vehicle has been operating for at least 1000 hours. All other measurements are conducted at 6 month intervals. These semi-annual measurements are performed in February and August. The data is plotted as a function of Temperature vs. Cathode loading percentage, and is dependent upon the cathode current density. That is, the percent current-equals 100 when the current loading is 2 amperes per square centimeter and the current drain is 100 ma. Table 3.2 shows the Cathode Activity data sheet. This data sheet is annotated during the measurement process to obtain the Miram curve data. There are twenty entries in the table. The general procedure in obtaining the data is to record 5 values in the temperature limited region, 5 values in the space charged region and 10 values in between such that the knee of the curve is well defined.

3.3.1 Measurement Procedure

With cooling on, slowly increase the cathode temperature to 1100 degrees centigrade employing the type pyrometer specified for the vehicle. Keep the heater surge current to a maximum of twice the amount specified by the manufacturer for 1100 degrees. Set the anode bias if any. Slowly raise the cathode and collector voltage (keeping col V = 0.70 x cath V +/-5%) to achieve the current that represents the desired cathode loading for that vehicle. During this process, the body current must be less than 5 milliamp. An exception occurs with the SIEMANS MK cathodes or other magnetically focused vehicles. With these, at the desired temperature, all other voltages are preset but not initially applied to the tube. When all voltages are established they are then simultaneously applied. For either procedure, the values will interact slightly and must be iteratively adjusted until desired loading is obtained at the correct temperature. When the loading density selected has been achieved, record all parameters. The cathode voltage measured <u>shall be maintained</u> for <u>all</u> future MIRAM curves.

Let the cathode stabilize for 60 minutes at the starting temperature (usually 1100 degrees) and record all parameters. Next, reduce the filament power to reduce cathode temperature by approximately 10 degrees (8 to 12), wait 5 minutes, record all parameters and reduce temperature another 10 degrees.

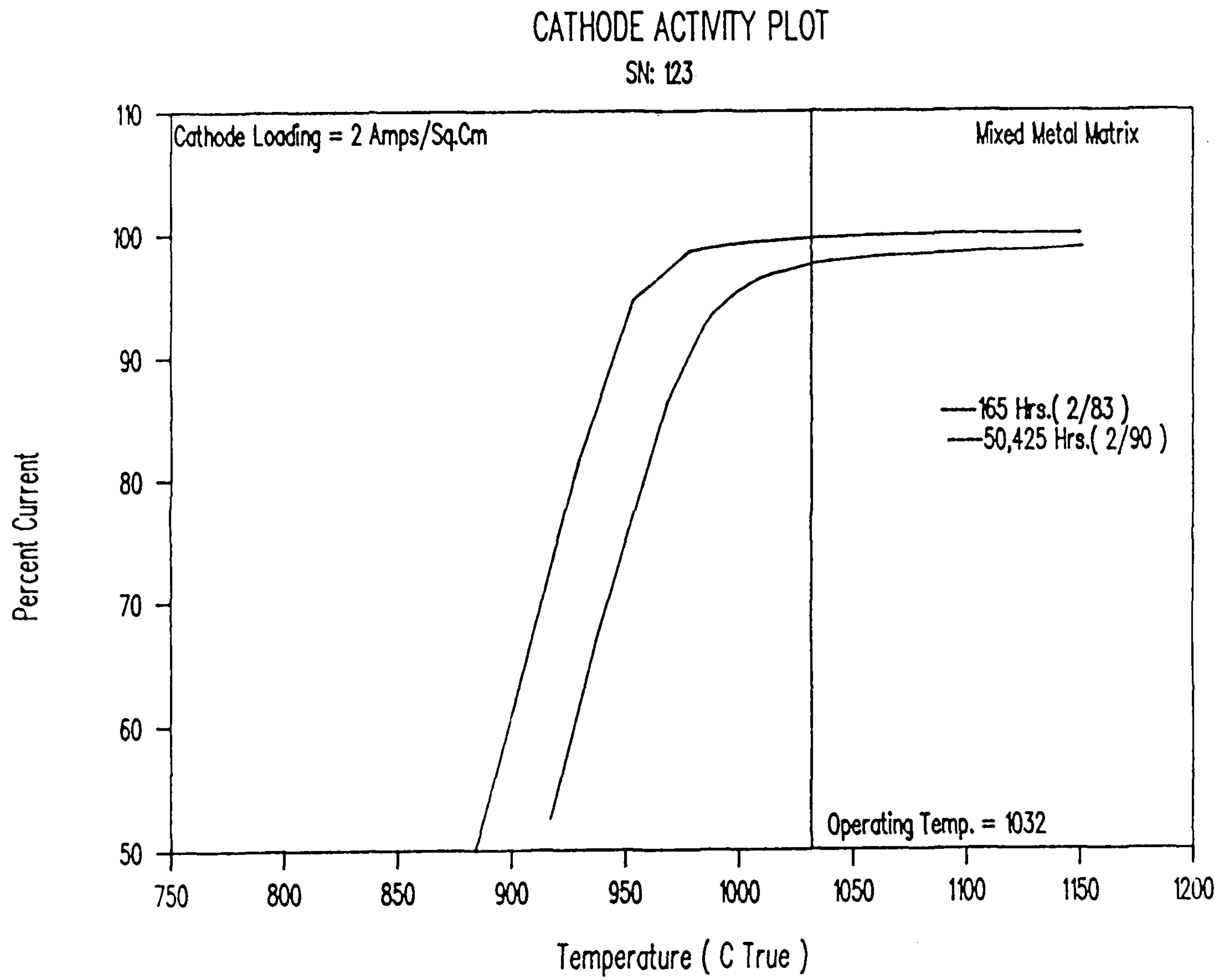


Figure 3-3 Miram Plot

Table 3.2 Cathode Activity Data Sheet

RADC/OCTP CATHODE LIFE TEST FACILITY

CATHODE ACTIVITY DATA SHEET

TEST VEHICLE TYPE ____________________ ETM ________________ DATE ________________

MFR ____________ S/N________ PYRO # ____________ RECORDER ____________________

TOTAL LIFE HRS ______________

TEMP	FILAMENT		CATHODE		COLLECTOR		BODY	CATHODE
°C T/B	VOLT	AMPS	VOLT	mAMP	VOLT	mAMP	mAMP	%FSCL

RETEST DATE ____________________ ETM __________________ PYRO # ______________

TOTAL LIFE HRS ______________

Repeat this procedure until cathode current has decreased by at least 50%. At this point, set the test vehicle to its normal life test condition.

The temperature and percent current data is transferred and stored into the facilities computer and the data sheet is archived for future reference.

3.4 Two Color Pyrometer

The two color pyrometer, manufactured by Ircon Inc., is a MODLINE R Series infrared thermometer. It is a completely modular non-contact temperature measurement and control system consisting of two units. The SENSING HEAD senses the infrared radiation emitted by a heating object and supplies and electrical signal to the indicator unit. For thermionic cathode measurements, use the 'A2' lens. The INDICATOR Unit provides a signal, linear with temperature, to produce a front panel display of temperature in degrees. The two color pyrometer measures temperature by comparison of infrared radiation levels at two wavelengths and computes the temperature, in degrees 'C' true, based upon the ratio of the two radiation signals. For detailed information the reader is referred to the two color pyrometers' Operations Manual.

3.4.1 Temperature Measurements Using a Two Color Pyrometer

A technique has been developed which permits repeatable temperature measurements on cathode test vehicles using a two color pyrometer. Duplicating measured data using pyrometer instrumentation is at best difficult and requires precise orientation of the pyrometer from one set of measurements to another. The method discussed here involved both a modification to the pyrometer fixture as well as procedural changes for establishing the location of the pyrometer referenced to the test vehicle. This technique has been demonstrated and is currently employed on the transition metal vehicles in the cathode facility.

In order to achieve precise positioning of the pyrometer to the test vehicle, modifications to the existing pyrometer fixture were made. Two single axis micrometer positioners were fastened together such that the axes were perpendicular to each other. The positioners were then placed between the pyrometer and its tripod base, thus permitting micromotion adjustment of the pyrometer in two planes. Additionally, two calibrated displacement rods were bolted perpendicular to the face plate of the pyrometer to ensure identical focal plane positioning from measurement to measurement. The focal plane was set to be centered in the pyrometers operating focal length and the latter is approximately eleven inches. This configuration is shown in Figure 3-4.

3.4.1.1 Setup Procedure

Upon receipt, new test vehicles are inspected and mounted in their respective chambers where they remain throughout the entire life test measurement program. Initial Miram plot measurements serve as a baseline for data comparison and vehicle performance analysis. The setup of the pyrometer instrumentation for these measurements is critical. The first step is to position the pyrometer in front of the vehicle chamber such that the pyrometer lens is in line with the chamber window. Using the roll and pitch adjustments on the tripod, ensure the pyrometer is level in the X and Y planes and plumb in the Z plane. The yaw adjustment on the tripod is used to set the displacement rods, and consequently the pyrometer measurement plane perpendicular to the vehicle chamber. The micrometer positioners and the tripod's vertical displacement adjustment are used to fine tune position the test vehicle's cathode, directly in the center of the

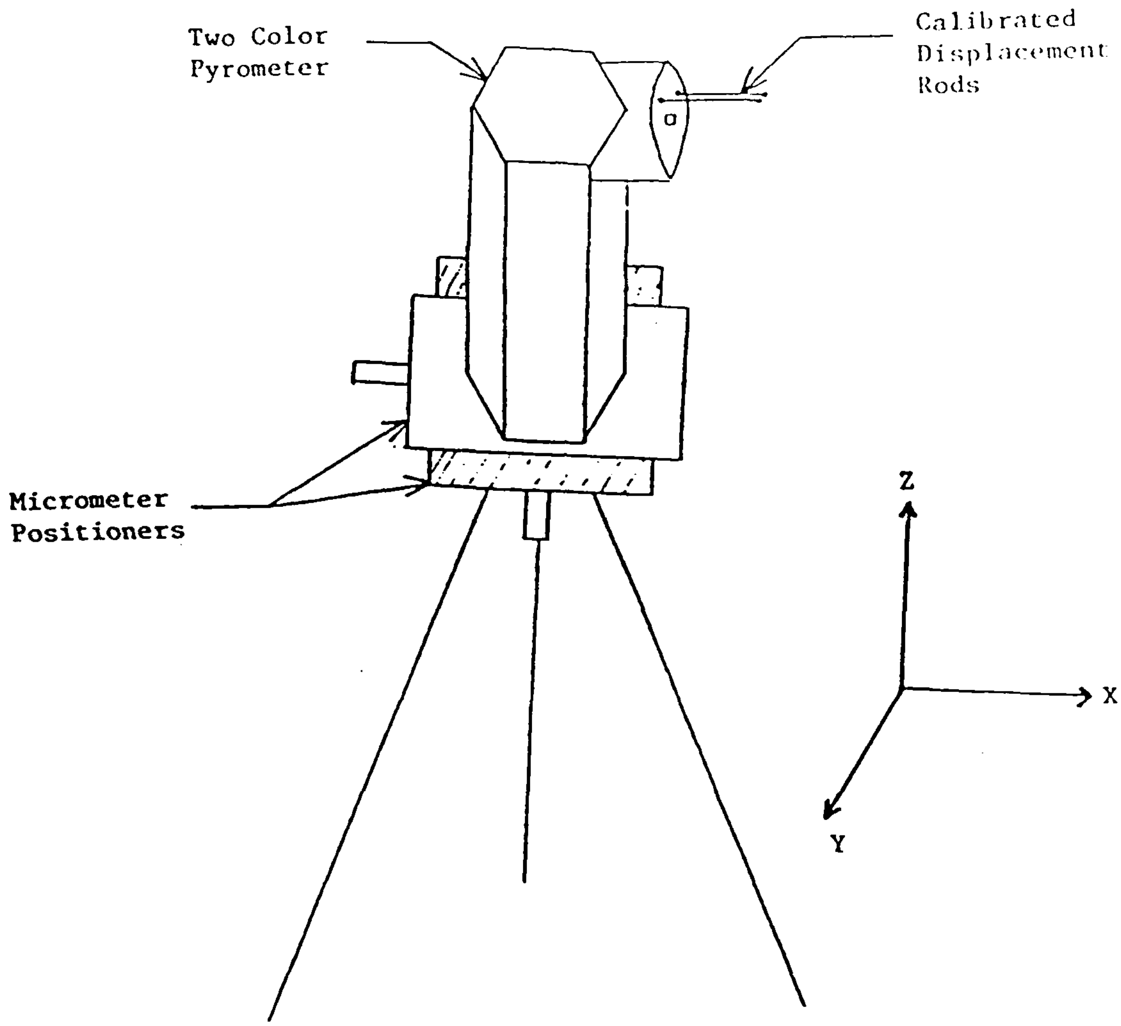


Figure 3-4 Pyrometer Fixture

pyrometer's eye, and at the appropriate focal distance. The X axis micrometer positioner is adjusted such that the tips of the displacement rods touch the front panel of the vehicle chamber. To guarantee perpendicularity, the contact made between each rod and the front panel should be identical. This final configuration is shown in Figure 3-5. Upon completion of the instrumentation orientation, the set up parameters are confirmed to be level, plumb, centered, and properly distanced. Once this is accomplished, a cross mark or dot is placed on the front panel of the vehicle chamber at the tip of each calibrated displacement rod. These marker points are used to reposition the pyrometer instrumentation prior to subsequent Miram plot measurements. Thus with proper leveling and positioning of the pyrometer, repeatable temperature measurements are achievable.

3.4.1.2 Data Comparison

The data for seven Miram plots on four different transition metal test vehicles has been recorded for the purpose of repeatability analysis. Morning and afternoon measurements were performed on test vehicles TM-B1455, TM-B1672, and TM-B1135, while daily measurements were performed on test vehicle TM-B1667. The results of these repeatability experiments are shown in Figure 3-6 through 3-12.

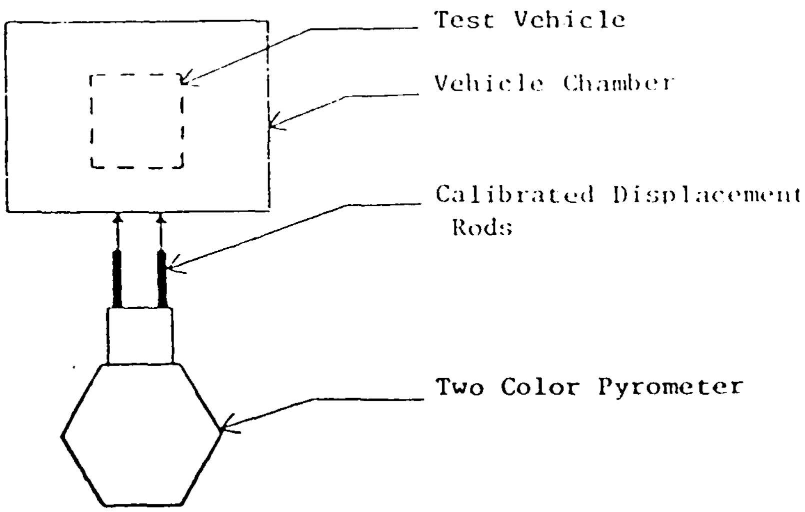
Following each measurement, the pyrometer instrumentation was physically moved away from the vehicle chamber and was reset accordingly to the described procedure prior to repeating measurements. Numerical analysis of the data reveals that by employing this technique the average RMS temperature measurement difference was 1.21°C with a standard deviation of 0.49°C. This is an improvement by a factor of greater than two when the same experienced individual performs the measurements using the previous technique, and an improvement by a factor of about three when two different individuals perform the same measurement.

3.5 Disappearing Filament Pyrometer

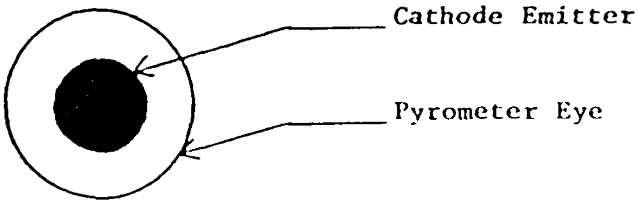
The Pyrometer Instrument micro-optical, model 95 pyrometer is used for measuring temperature in degrees 'C' brightness. For temperature measurements within the Cathode facility a 'D' type lens is used. The 'D' lens places the focal region between 13.5 and 17.5 inches. The test cathode is positioned approximately 6 1/4 inches back from the window of the power supply enclosure. Placing the pyrometer 9 inches in front of the power supply window, positions the device approximately 15 1/4 inches away from the cathode, which is centered within the pyrometers focal region. Using a small level, the pyrometer should be leveled, plumbed and maintained in that orientation throughout the duration of the test. For consistency, adjust the filament from below the cathode temperature, up to the level where the filament disappears. Detailed discussion of the actual operation and reading of the disappearing filament Pyrometer may be found in its operating manual.

3.6 Data Storage

Presently, the Cathode Life Test facility uses a Zenith Z-150 personal computer which is an IBM XT compatible machine. The Z-150 utilizes removable 10 megabyte hard disks and 5 1/4 inch floppy disks. Two hard disks are required for data storage. The first, labeled "Cathode Lab data -1", contains historical information relating to test vehicle parameters and conditions. It also contains power supply data which includes parts, part numbers, and spares



(A)



(B)

Figure 3-5 Pyrometer Setup

a) Displacement Rod Positioning
b) Cathode Emitter Centering

CATHODE REPEATABILITY TEST PLOT
SN: TM-B1455

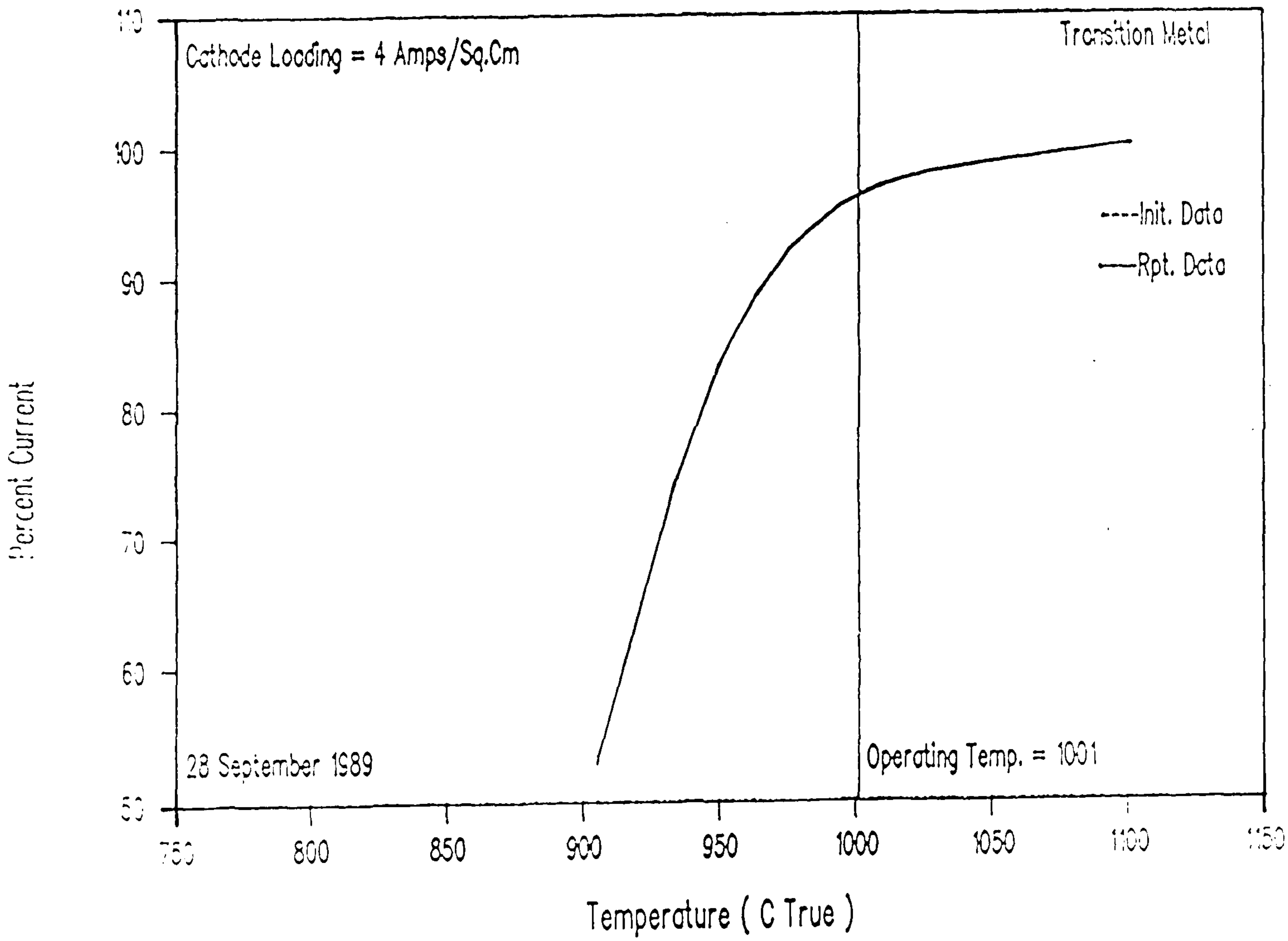
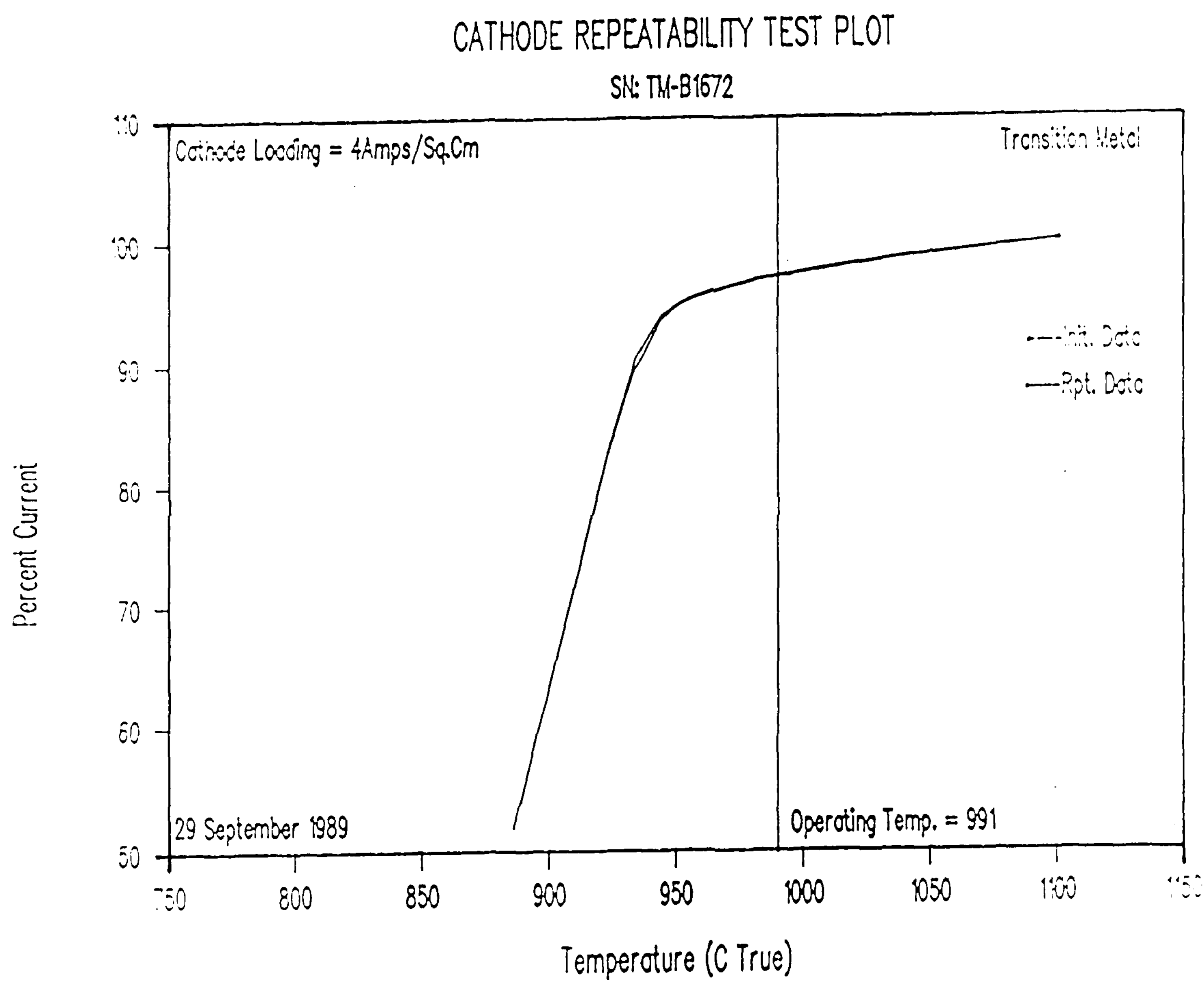
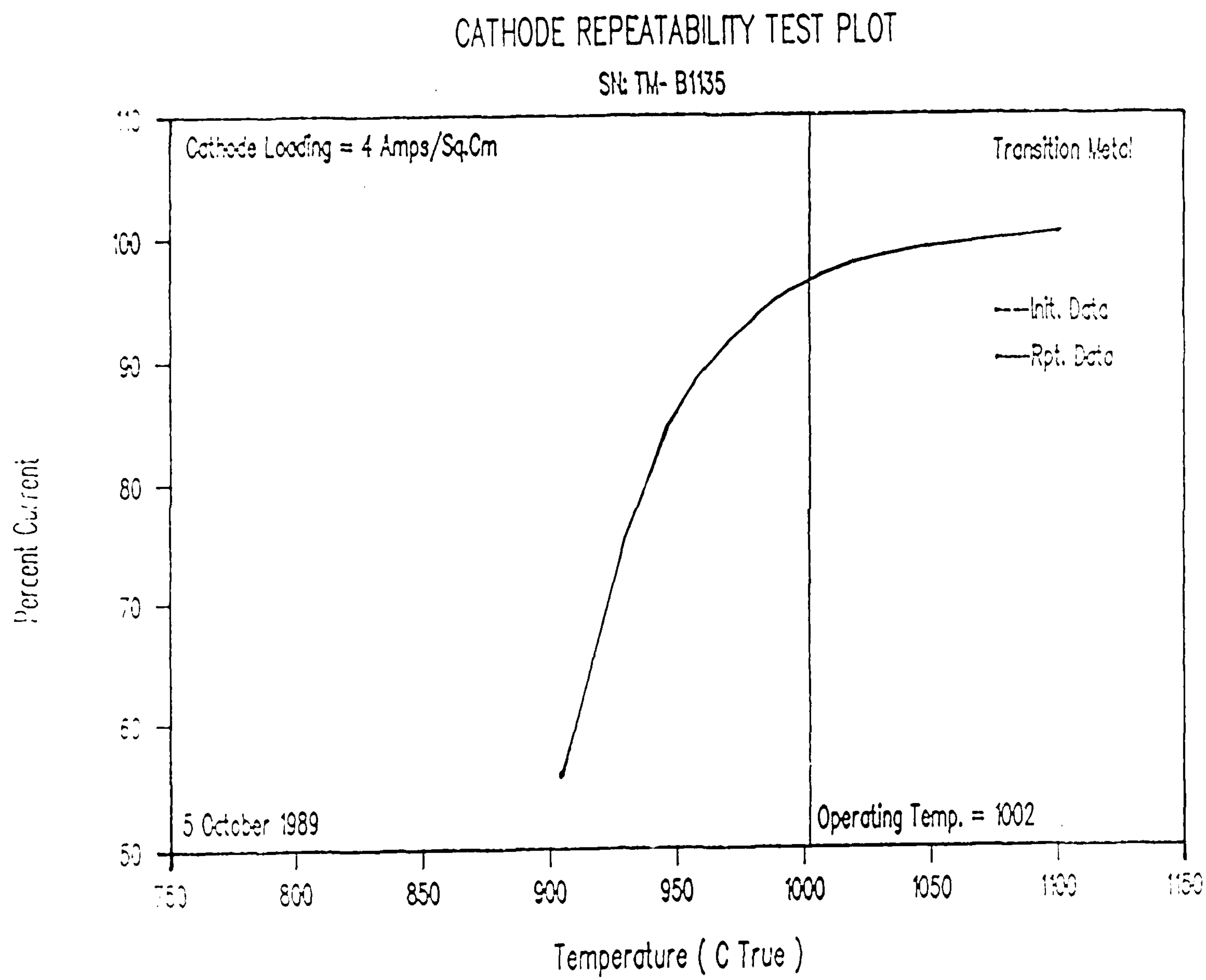


Figure 3-6



CATHODE REPEATABILITY TEST PLOT
SN: TM-B1672
Cathode Loading = 4Amps/Sq.Cm
Transition Metal
Init. Data
Rpt. Data
29 September 1989
Operating Temp. = 991
Percent Current
Temperature (C True)
50
60
70
80
90
100
110
750
800
850
900
950
1000
1050
1100
1150

Figure 3-7



CATHODE REPEATABILITY TEST PLOT
SN: TM- B1135
Cathode Loading = 4 Amps/Sq.Cm
Transition Metal
Init. Data
Rpt. Data
5 October 1989
Operating Temp. = 1002
100
90
80
70
50
800
850
900
950
1000
1050
Percent Current
Temperature (C True)

Figure 3-8

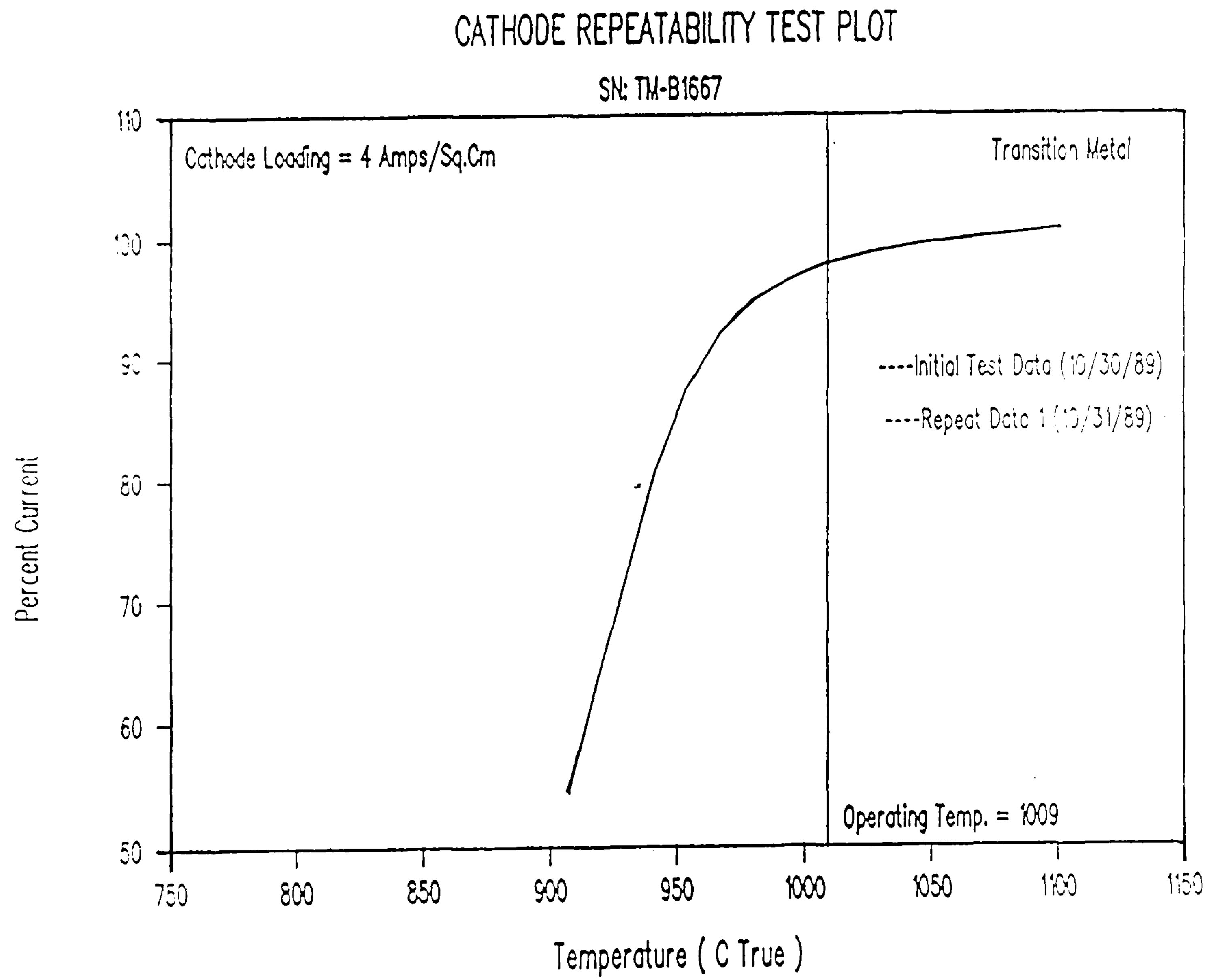
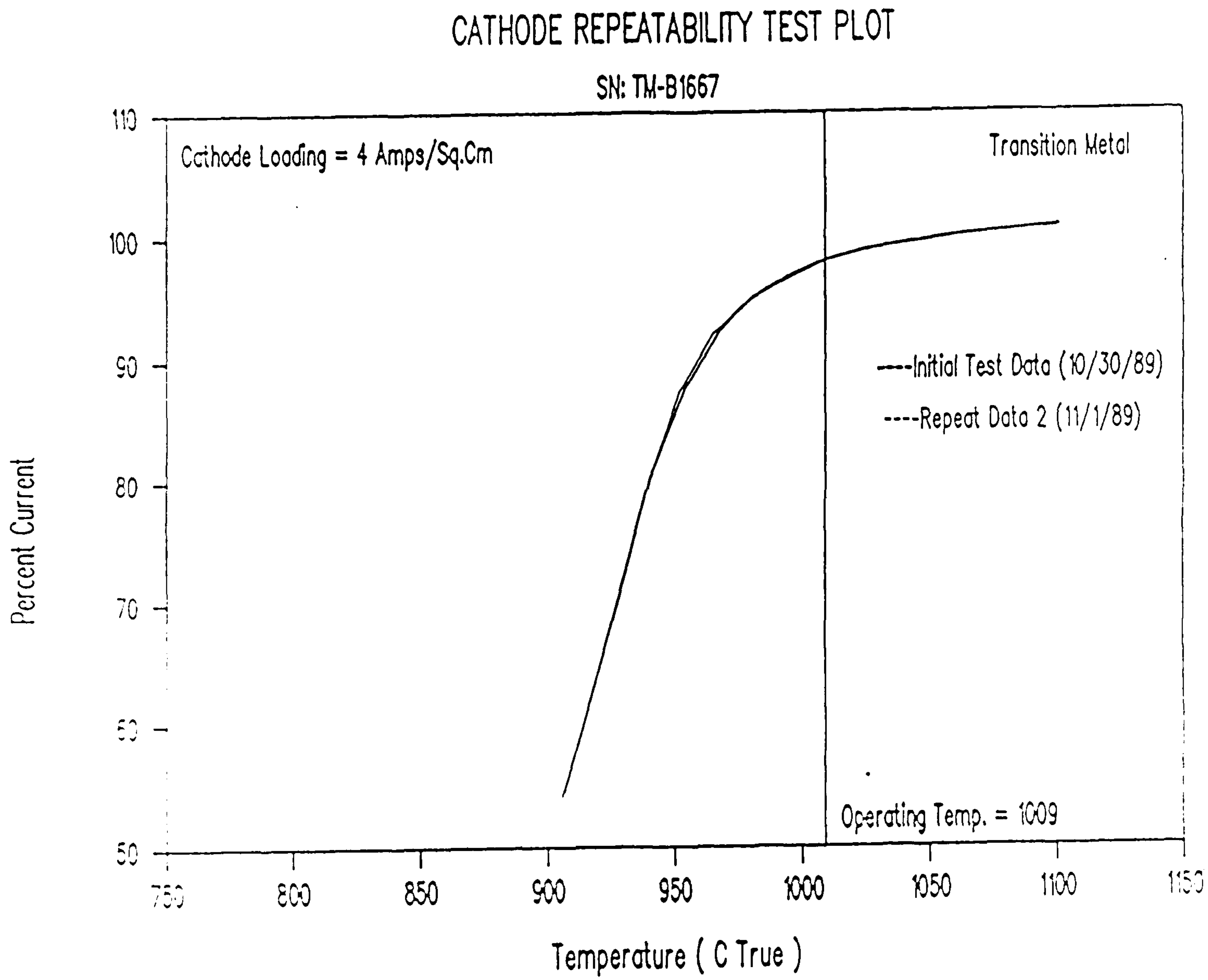

CATHODE REPEATABILITY TEST PLOT
SN: TM-B1667
Cathode Loading = 4 Amps/Sq.Cm
Transition Metal
----Initial Test Data (10/30/89)
----Repeat Data 1 (10/31/89)
Operating Temp. = 1009
Percent Current
110
100
90
80
70
60
50
750
800
850
900
950
1000
1050
1100
1150
Temperature (C True)

Figure 3-9



CATHODE REPEATABILITY TEST PLOT
SN: TM-B1667
Cathode Loading = 4 Amps/Sq.Cm
Transition Metal
----Initial Test Data (10/30/89)
----Repeat Data 2 (11/1/89)
Operating Temp. = 1009
Percent Current
110
100
90
80
70
50
750
800
850
900
950
1000
1050
1100
1150
Temperature (C True)

Figure 3-10

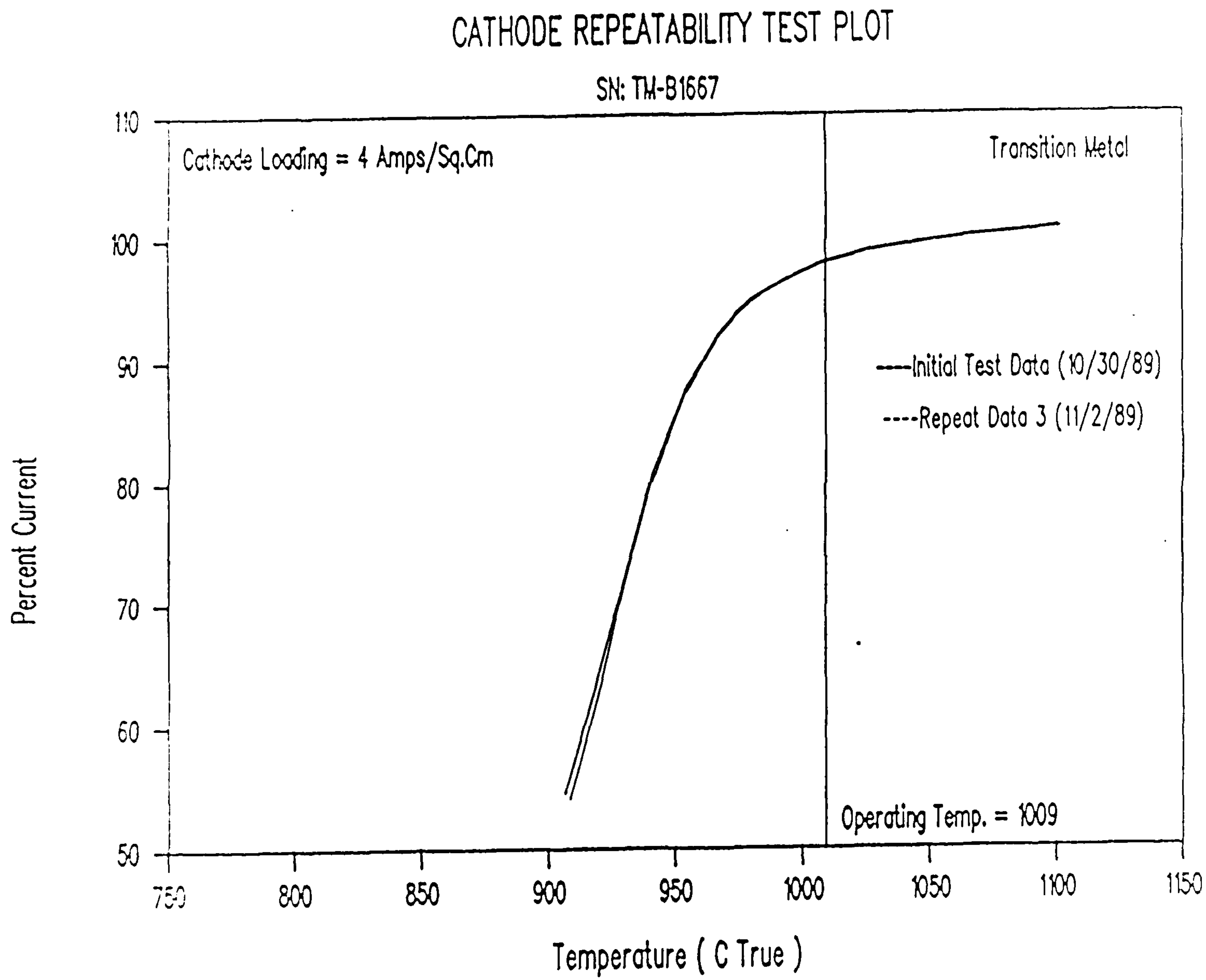

CATHODE REPEATABILITY TEST PLOT
SN: TM-B1667
Cathode Loading = 4 Amps/Sq.Cm
Transition Metal
----Initial Test Data (10/30/89)
----Repeat Data 3 (11/2/89)
Operating Temp. = 1009
110
100
90
80
70
60
50
Percent Current
750
800
850
900
950
1000
1050
1100
1150
Temperature (C True)

Figure 3-11

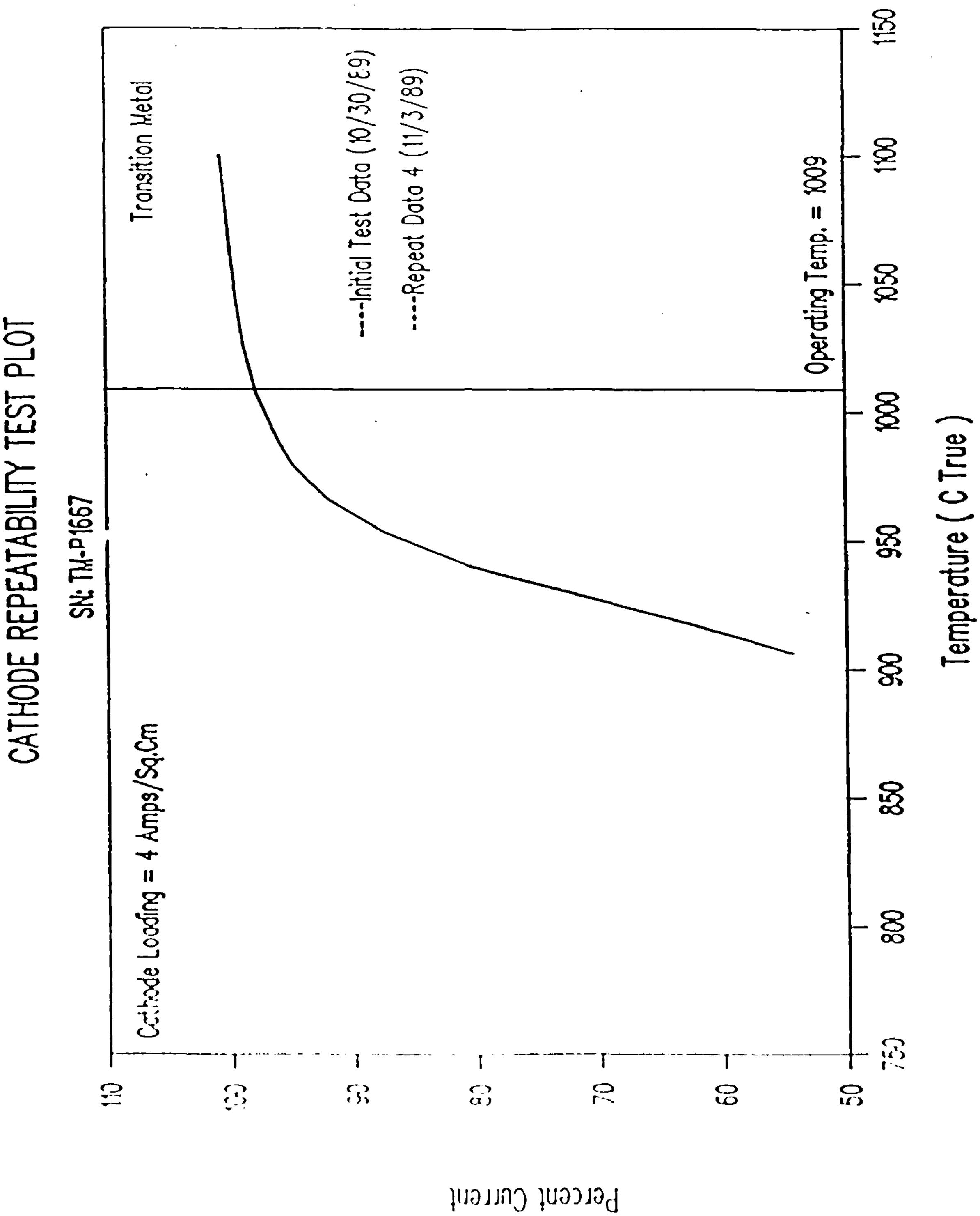

CATHODE REPEATABILITY TEST PLOT
SN: TM-P1667
Cathode Loading = 4 Amps/Sq.Cm
Transition Metal
----Initial Test Data (10/30/89)
----Repeat Data 4 (11/3/89)
Operating Temp. = 1009
Temperature (C True)
Percent Current
110
100
90
80
70
60
50
750
800
850
900
950
1000
1050
1100
1150

Figure 3-12

on hand. And lastly, it contains monthly condition reports of the test vehicles and their power supplies. Tables 3.3, 3.4 and 3.5 show the spread sheets, which were developed using Lotus 1 2-3, on the test vehicles, power supplies and the monthly vehicle status respectively. The second hard disk, labeled "Cathode Lab data -2", is a data disk. It contains raw measurement data, processed data, and the data plotting program. The program used to plot the data is TECH*GRAPH*PAD. The 5 1/4 inch floppies are used as back up media, and the original hardcopy data is archived in the cathode facility. Duplicate copies are also given to the facility manager.

3.7 Filenames

In order to facilitate recognition and differentiation between data files, a standardized format for naming files was developed. The filename is an eleven character identifier which includes the DOS three character extension. The filename structure and breakdown is as follows:

X X X X X X X X. X X X
1 2 3 4 5 6 7 8.9 10 11

The first two characters identify the Vehicle Code.

i.e.: RV - Reservoir-Epsilon Phase
TL - Trilayer Series
SM - Semicon 'M' Type
HM - Hughes 'M' Type
M3 - Mixed Metal Matrix
TM - Transition Metal
MK - Siemans MK series

The third, fourth, fifth and sixth characters identify the test vehicles serial number.

i.e.: 1135
0021

The seventh and eighth characters identify the month the data was recorded.

i.e.: 01
12

The ninth character identifies the type of data file.

i.e.: D - raw data file
G - Graph data file
R - repeat data file
T - temperature data file

Characters ten and eleven identify the year the data was recorded/processed in.

An example of a typical filename and its breakdown is as follows:

TL001202.D90

This particular file contains raw measurement on a trilayer series cathode whose serial number is 12. Furthermore, the data was recorded in February of 1990.

4.0 Documentation

Constant and accurate facility documentation ranks second only to performing accurate measurements and obtaining realistic data. Several log books are maintained for historical and analysis purposes, and must be annotated regularly to preserve the integrity of the facility and the measurement data. The facility manager will also be informed of any unusual occurrences which may arise in the facility.

4.1 Daily Logbook

The daily logbook is used to record the daily activities which occur in the facility. It is kept within the facility and should be updated at the end of each working day.

4.2 Vehicle Logbook

There is a logbook associated with each type of test vehicle which is kept within the facility. The logbooks are black 3 ring binders and are organized according to the vehicles serial numbers. They contain the manufacturers documentation which includes schematics, safety and operating procedures and initial measurement data. These logbooks are also used to archive the Cathode activity data sheets, table 3.2, which contain the measurement data recorded for the Miram plots.

4.3 Power Supply Repair Logbook

The power supply repair logbook is a red 3 ring binder which contains historical repair and maintenance data on all 40 supplies in the facility. The logbook is sectionalized according to the supply's Equipment Management and Accounting System (EMAS) identification number and is updated whenever a maintenance or repair operation is performed.

Table 3.3 Test Vehicle Data

THE RADC/OCTP CATHODE LIFE TEST FACILITY DATA SHEET

JUL 31,1990

	VEHICLE DATA					POWER SUPPLY DATA				TEST CONDITION DATA							
	TYPE	MFR	S/N	LOAD I DENSITY	KNEE TEMP DEG C T/B	RADC #	MFR	MODEL#	S/N	DATE TEST STARTED	INITIAL P/S ETM	OP TEMP T 1f	CALC/ GIVEN	FILAMENT V 1f	FILAMENT I 1f	CATH V 1f	COLL V 1f
1	MK	SIEMENS	2	2A/SQ CM	907 DEG C B	C012629B	COBER	3260	3260-4	3/6/85	25460.0	1020 DEG C B	GIVEN	5.39	1.29A	2650	2110
2	MK	SIEMENS	4	4A/SQ CM	949 DEG C B	C012628A	COBER	3260	3260-7	6/18/85	10492.0	1060 DEG C B	GIVEN	6.05	1.35A	4170	3760
3	MK	SIEMENS	8	4A/SQ CM	928 DEG C B	C012646B	COBER	3260	3260-1	10/9/85	15630.0	1060 DEG C B	GIVEN	6.10	1.37A	4210	3700
4	MK	SIEMENS	12	2A/SQ CM	897 DEG C B	C012644B	COBER	3260	3260-3	8/5/85	123.7 *	1020 DEG C B	GIVEN	5.22	1.23A	2580	2090
5	MK	SIEMENS	17	4A/SQ CM	961 DEG C B	C012646A	COBER	3260	3260-2	10/22/85	13641.0	1060 DEG C B	GIVEN	6.13	1.39A	4200	3850
6	M	SEMICON	202	2A/SQ CM	930 DEG C T	C012645A	RADC	HVPS-1	RADC-1	7/17/84	2875.0 *	1018 DEG C T	CALC	5.40	2.21A	3710	2650
7	M	SEMICON	209	2A/SQ CM	914 DEG C T	C012639B	COBER	3399	3399-15	7/11/84	50341.6 *	957 DEG C T	CALC	4.66	2.09A	3812	2815
8	M	HUGHES	212	4A/SQ CM	949 DEG C T	C012634A	COBER	3399	3399-12	10/20/85	18764.0	1013 DEG C T	CALC	5.90	2.29A	5792	4305
9	M	SEMICON	210	2A/SQ CM	910 DEG C T	C012633A	COBER	3399	3399-5	6/25/90	37233.3	960 DEG C T	CALC	4.52	2.00A	3860	2752
10	M	SEMICON	215	2A/SQ CM	898 DEG C T	C012642B	COBER	3399	3399-22	7/12/90	31557.9	948 DEG C T	CALC	4.50	1.97A	3875	2956
11	M	SEMICON	218	2A/SQ CM	899 DEG C T	C012647B	COBER	3399	3399-27	7/18/90	1846.9	945 DEG C T	CALC	4.58	2.00A	4750	2668
12	TRILAYER	VARIAN	012	4A/SQ CM	928 DEG C T	C012633B	COBER	3399	3399-7	9/17/85	0.0 *	985 DEG C T	CALC	5.31	2.26A	6115	4495
13	MMM	VARIAN	120	2A/SQ CM	968 DEG C T	C012630A	COBER	3399	3399-16	9/22/82	0.0 *	1018 DEG C T	CALC	5.50	2.22A	3346	2480
14	MMM	VARIAN	121	2A/SQ CM	963 DEG C T	C012635B	COBER	3399	3399-18	12/17/82	0.0 *	988 DEG C T	CALC	5.36	2.23A	3345	2520
15	MMM	VARIAN	122	2A/SQ CM	996 DEG C T	C012634B	COBER	3399	3399-8	3/1/83	22787.5 *	1021 DEG C T	CALC	5.68	2.36A	3753	2835
16	MMM	VARIAN	123	2A/SQ CM	982 DEG C T	C012637B	COBER	3399	3399-25	12/18/82	385.0	1032 DEG C T	CALC	5.95	2.45A	3558	2685
17	MMM	VARIAN	124	2A/SQ CM	969 DEG C T	C012638A	COBER	3399	3399-13	1/14/83	33760.6 *	994 DEG C T	CALC	5.35	2.39A	3710	2787
18	MMM	VARIAN	125	2A/SQ CM	985 DEG C T	C012639A	COBER	3399	3399-10	1/18/83	46730.4 *	1010 DEG C T	CALC	5.81	2.30A	3645	2840
19	TM	VARIAN	B1135	4A/SQ CM	952 DEG C T	C012630B	COBER	3399	3399-17	8/22/89	32731.2	1002 DEG C T	CALC	5.15	2.05A	5761	4205
20	TM	VARIAN	B1240	4A/SQ CM	938 DEG C T	C012636A	COBER	3399	3399-20	10/31/89	45128.0	988 DEG C T	CALC	5.14	2.18A	5500	4250
21	TM	VARIAN	B1350	4A/SQ CM	939 DEG C T	C012631B	COBER	3399	3399-30	8/23/89	43193.6	989 DEG C T	CALC	5.15	2.14A	5778	4164
22	TM	VARIAN	B1352	4A/SQ CM	949 DEG C T	C012636B	COBER	3399	3399-26	11/1/89	45866.6	999 DEG C T	CALC	5.09	2.24A	5710	4095
23	TM	VARIAN	B1455	4A/SQ CM	951 DEG C T	C012631A	COBER	3399	3399-6	8/15/89	50063.5	1001 DEG C T	CALC	5.10	2.12A	5950	4300
24	TM	VARIAN	B1462	4A/SQ CM	927 DEG C T	C012632A	COBER	3399	3399-24	8/9/89	41572.5	977 DEG C T	CALC	5.03	2.02A	5920	4402
25	TM	VARIAN	B1565	4A/SQ CM	926 DEG C T	C009808B	COBER	3399	3399-14	8/25/89	17501.6	976 DEG C T	CALC	4.87	2.05A	5919	4260
26	TM	VARIAN	B1667	4A/SQ CM	959 DEG C T	C012635A	COBER	3399	3399-19	8/25/89	33274.9	1009 DEG C T	CALC	4.78	2.09A	5710	4120
27	TM	VARIAN	B1671	4A/SQ CM	963 DEG C T	C012637A	COBER	3399	3399-29	11/2/89	44332.7	1013 DEG C T	CALC	5.07	2.12A	5505	3850
28	TM	VARIAN	B1672	4A/SQ CM	940 DEG C T	C012632B	COBER	3399	3399-23	8/16/89	44655.0	990 DEG C T	CALC	4.95	2.03A	5857	4389
29	RV	VARIAN	A002	4A/SQ CM	932 DEG C T	C012638B	COBER	3260	3399-9	3/23/90	45446.5	972 DEG C T	CALC	6.93	2.49A	5288	3926
30	RV	VARIAN	A003	2A/SQ CM	888 DEG C T	C012641A	COBER	3260	3399-21	3/12/90	27554.5	928 DEG C T	CALC	6.10	2.27A	3760	2850
31	RV	VARIAN	A005	2A/SQ CM	912 DEG C T	C012643A	COBER	3399	3399-4	3/6/90	25224.0	952 DEG C T	CALC	6.33	2.41A	3648	2710
32	RV	VARIAN	A006	4A/SQ CM	928 DEG C T	C012640A	COBER	3399	3399-1	3/19/90	44856.6	968 DEG C T	CALC	6.73	2.40A	5790	4216
33	RV	VARIAN	A007	4A/SQ CM	908 DEG C T	C012640B	COBER	3399	3399-2	3/21/90	43321.0	948 DEG C T	CALC	6.87	2.47A	5485	4347
34	RV	VARIAN	A008	2A/SQ CM	893 DEG C T	C012641B	COBER	3399	3399-28	3/14/90	30017.5	933 DEG C T	CALC	6.19	2.29A	3660	2850
35	RV	VARIAN	A009	2A/SQ CM	894 DEG C T	C012643B	COBER	3399	3399-3	3/15/90	27655.0	934 DEG C T	CALC	6.18	2.24A	3430	2430
36	No Vehicle Installed					C012628B	COBER	3260	3260-8								
37	No Vehicle Installed					C012629A	COBER	3260	3260-6								
38	No Vehicle Installed					C012644A	COBER	3260	3260-5								
39	No Vehicle Installed					C012645B	RADC	HVPS-1	RADC-2								
40	No Vehicle Installed					C012647A	COBER	3260	3260-7 SP								

* THIS NUMBER REPRESENTS THE INITIAL TIME OF THE REPLACEMENT ETM OR NEW POWER SUPPLY

CATHODE LAB POWER SUPPLY INFORMATION DATA

Table 3.4 Power Supply Data

	RADC #	MFR	MODEL #	S/N	4.5 DIGIT METERS	MFR	MODEL #	PART #	SPARES	3.5 DIGIT METERS	MFR	MODEL #	PART #	SPARES
1	C012628A	COBER	3260	3260-7	1	DATEL	4101L		0	5	DATEL	3100B		2
2	C012628B	COBER	3260	3260-8	1	DATEL	4101L		0	5	DATEL	3100B		2
3	C012629A	COBER	3260	3260-4	1	DATEL	4101L		0	5	DATEL	3100B		2
4	C012629B	COBER	3260	3260-6	1	DATEL	4101L		0	5	DATEL	3100B		2
5	C012630A	COBER	3399	3399-16	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
6	C012630B	COBER	3399	3399-17	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
7	C012631A	COBER	3399	3399-6	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
8	C012631B	COBER	3399	3399-30	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
9	C012632A	COBER	3399	3399-24	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
10	C012632B	COBER	3399	3399-23	3	DYNAMIC SCIENCES	54	540520	76	3	DYNAMIC SCIENCES	73	730520	67
11	C012633A	COBER	3399	3399-5	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
12	C012633B	COBER	3399	3399-7	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
13	C012634A	COBER	3399	3399-12	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
14	C012634B	COBER	3399	3399-8	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
15	C012635A	COBER	3399	3399-19	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
16	C012635B	COBER	3399	3399-18	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
17	C012636A	COBER	3399	3399-20	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
18	C012636B	COBER	3399	3399-26	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
19	C012637A	COBER	3399	3399-29	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
20	C012637B	COBER	3399	3399-25	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
21	C012638A	COBER	3399	3399-13	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
22	C012638B	COBER	3399	3399-9	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
23	C012639A	COBER	3399	3399-10	3	DYNAMIC SCIENCES	54	540520	76	3	DYNAMIC SCIENCES	73	730520	67
24	C012639B	COBER	3399	3399-15	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
25	C012640A	COBER	3399	3399-1	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
26	C012640B	COBER	3399	3399-2	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
27	C012641A	COBER	3399	3399-21	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
28	C012641B	COBER	3399	3399-28	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
29	C012642B	COBER	3399	3399-22	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
30	C012643A	COBER	3399	3399-4	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
31	C012643B	COBER	3399	3399-3	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67
32	C012644A	COBER	3260	3260-5	1	DATEL	4101L		0	5	DATEL	3100B		2
33	C012644B	COBER	3260	3260-3	1	DATEL	4101L		0	5	DATEL	3100B		2
34	C012645A	RADC	HVPS-1	RADC-1	3	DYNAMIC SCIENCES	54	540520	76	1	DYNAMIC SCIENCES	73	730520	67
35	C012645B	RADC	HVPS-1	RADC-2	3	DYNAMIC SCIENCES	54	540520	76	1	DYNAMIC SCIENCES	73	730520	67
36	C012646A	COBER	3260	3260-2	0	DATEL	4101L		0	6	DATEL	3100B		2
37	C012646B	COBER	3260	3260-1	0	DATEL	4101L		0	6	DATEL	3100B		2
38	C012647A	COBER	3260	3260-7 SP	0	DATEL	4101L		0	6	DATEL	3100B		2
39	C012647B	COBER	3260	3260-4 SP	0	DATEL	4101L		0	6	DATEL	3100B		2
40	C009808B	COBER	3399	3399-14	2	DYNAMIC SCIENCES	54	540520	76	4	DYNAMIC SCIENCES	73	730520	67

Table 3.4 Power Supply Data (concluded)

	LAMPS NO.	LAMPS TYPE	PART #	SPARES	FUSES NUMBER/RATING	SPARES 12A	7A	6A	5A	2A	1A	.5A	DATE VEHICLE INSTALLED	MFR	TYPE VEHI S/N	LOAD I DENSITY	INITIAL ETM
1	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	6/18/85	SIEMENS	MK 4	4A/SQ CM	10,492.0
2	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	NO VEHICLE PRESENTLY INSTALLED				
3	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	3/6/85	SIEMENS	MK 2	2A/SQ CM	25,460.0
4	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	NO VEHICLE PRESENTLY INSTALLED				
5	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	9/22/82	VARIAN	MMM 120	2A/SQ CM	0.0 *
6	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/22/89	VARIAN	TM-B1135	4A/SQ CM	32,731.2
7	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/15/89	VARIAN	TM-B1455	4A/SQ CM	50,063.5
8	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/23/89	VARIAN	TM-B1350	4A/SQ CM	43,193.6
9	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/9/89	VARIAN	TM-B1462	4A/SQ CM	41,572.5
10	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/16/89	VARIAN	TM-B1672	4A/SQ CM	44,655.0
11	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	6/25/90	SEMICON	M-210	2A/SQ CM	37,233.3
12	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	9/17/85	VARIAN	TRI 012	4A/SQ CM	0.0 *
13	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	10/20/85	HUGHES	M 212	4A/SQ CM	18,764.0
14	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/1/83	VARIAN	MMM 122	2A/SQ CM	22,787.5*
15	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/25/89	VARIAN	TM-B1667	4A/SQ CM	33,274.9
16	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	12/17/82	VARIAN	MMM 121	2A/SQ CM	0.0 *
17	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	10/31/89	VARIAN	TM-B1240	4A/SQ CM	45,128.0
18	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	11/1/89	VARIAN	TM-B1352	4A/SQ CM	45,866.6
19	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	11/2/89	VARIAN	TM-B1671	4A/SQ CM	44,332.7
20	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	12/18/82	VARIAN	MMM 123	2A/SQ CM	385.0
21	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	1/14/83	VARIAN	MMM 124	2A/SQ CM	33,760.6*
22	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/23/90	VARIAN	RV-A002	4A/SQ CM	45,446.5
23	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	1/18/83	VARIAN	MMM 125	2A/SQ CM	46,730.4*
24	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	7/11/84	SEMICON	M 209	2A/SQ CM	50,341.6*
25	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/19/90	VARIAN	RV-A006	4A/SQ CM	44,856.6
26	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/21/90	VARIAN	RV-A007	4A/SQ CM	43,321.0
27	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/12/90	VARIAN	RV-A003	2A/SQ CM	27,554.5
28	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/14/90	VARIAN	RV-A008	2A/SQ CM	30,017.5
29	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	7/12/90	SEMICON	M-215	2A/SQ CM	31,557.9
30	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/6/90	VARIAN	RV-A005	2A/SQ CM	25,224.0
31	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	3/15/90	VARIAN	RV-A009	2A/SQ CM	27,655.0
32	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	NO VEHICLE PRESENTLY INSTALLED				
33	16	120MB	6240-00-939-7859	130	F1-12A,F2-5A,F3-.5A,F4-7A,F5-6A,F6,F7-1A	0	223	119	4	204	73	22	8/5/85	SIEMENS	MK 12	2A/SQ CM	123.7 *
34	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	7/17/84	SEMICON	M 202	2A/SQ CM	2,875.0 *
35	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	NO VEHICLE PRESENTLY INSTALLED				
36	16	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	10/22/85	SIEMENS	MK 17	4A/SQ CM	13,641.0
37	16	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	10/9/85	SIEMENS	MK 8	4A/SQ CM	15,630.0
38	16	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	NO VEHICLE PRESENTLY INSTALLED				
39	16	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	7/18/90	SEMICON	M-218	2A/SQ CM	1,846.9
40	14	120MB	6240-00-939-7859	130	F1-5A,F2-6A,F3-5A,F4-2A,F5-7A,F6,F7-1A	0	223	119	4	204	73	22	8/25/89	VARIAN	TM-B1565	4A/SQ CM	17,501.6

* THIS NUMBER REPRESENTS THE TIME OF THE REPLACEMENT ETM OR NEW POWER SUPPLY

Table 3.5 Vehicle Status

MONTHLY CATHODE LAB CONDITION REPORT

JULY 1990

	TYPE	S/N	MFR	P/S CO...	LOAD I DENSITY	PREVIOUS LIFE HRS.	ETM THIS MO.	ETM LAST MO.	LIFE HRS. THIS MO.	TOTAL LIFE HOURS	BODY CURRENT	COMMENTS
1	MK	2	SIEMENS	12629B	2A/SQ CM	27,151.8	52,732.5	52,047.4	685.1	27,836.9	0.8mA	
2	MK	4	SIEMENS	12628A	4A/SQ CM	30,818.3	43,782.4	43,097.4	685.0	31,503.3	0.3mA	
3	MK	8	SIEMENS	12646B	4A/SQ CM	29,829.3	45,473.4	44,839.4	634.0	30,463.3	0.4mA	
4	MK	12	SIEMENS	12644B	2A/SQ CM	28,222.6	8,294.1	7,608.7	685.4	28,908.0	0.1mA	
5	MK	17	SIEMENS	12646A	4A/SQ CM	29,884.9	43,560.5	42,926.7	633.8	30,518.7	0.5mA	
6	M	202	SEMICON	12645A	2A/SQ CM	35,611.4	31,197.7	30,511.4	686.3	36,297.7	1.0mA	
7	M	209	SEMICON	12639B	2A/SQ CM	43,227.9	52,779.6	52,099.3	680.3	43,908.2	1.0mA	
8	M	210	SEMICON	12633A	2A/SQ CM	163.0	37,929.2	37,296.7	632.5	795.5	1.25mA	Started lift test - 6/25
9	M	212	HUGHES	12634A	4A/SQ CM	32,277.8	52,227.7	51,541.8	685.9	32,963.7	2.2mA	
10	M	215	SEMICON	12642B	2A/SQ CM	53.8	31,996.6	31,557.9	438.7	492.5	1.0mA	Started life test - 7/12
11	M	218	SEMICON	12647B	2A/SQ CM	29.5	2,142.1	1,846.9	295.2	324.7	1.25mA	Started life test - 7/19
12	TRILAYER	012	VARIAN	12633B	4A/SQ CM	37,193.5	28,871.1	28,185.3	685.8	37,879.3	1.75mA	
13	MMM	120	VARIAN	12630A	2A/SQ CM	55,685.9	8,584.4	7,905.2	679.2	56,365.1	2.5mA	
14	MMM	121	VARIAN	12635B	2A/SQ CM	55,283.7	52,187.2	51,553.1	634.1	55,917.8	2.0mA	
15	MMM	122	VARIAN	12634B	2A/SQ CM	55,189.6	34,583.6	33,904.2	679.4	55,869.0	1.5mA	
16	MMM	123	VARIAN	12637B	2A/SQ CM	53,175.2	54,247.1	53,561.1	686.0	53,861.2	.6mA	
17	MMM	124	VARIAN	12638A	2A/SQ CM	55,664.8	45,294.7	44,615.2	679.5	56,344.3	.8mA	
18	MMM	125	VARIAN	12639A	2A/SQ CM	57,285.2	58,254.5	57,568.4	686.1	57,971.3	1.0mA	
19	TM	B1135	VARIAN	12630B	4A/SQ CM	7,081.9	40,031.4	39,352.1	679.3	7,761.2	2.0mA	
20	TM	B1240	VARIAN	12636A	4A/SQ CM	5,529.5	50,410.7	49,730.5	680.2	6,209.7	.5mA	
21	TM	B1350	VARIAN	12631B	4A/SQ CM	6,768.6	50,451.3	49,766.2	685.1	7,453.7	2.5ma	
22	TM	B1352	VARIAN	12636B	4A/SQ CM	5,574.7	51,182.3	50,496.3	686.0	6,260.7	1.0mA	
23	TM	B1455	VARIAN	12631A	4A/SQ CM	6,920.3	57,196.6	56,781.8	414.8	7,335.1	.5mA	

Table 3.5 Vehicle Status (concluded)

24	TM	B1462	VARIAN	12632A	4A/SQ CM	7,262.1	49,199.5	48,519.5	680.0	7,942.1	.75mA
25	TM	B1565	VARIAN	09808D	4A/SQ CM	6,793.7	24,784.2	24,098.3	685.9	7,479.6	4.0mA
26	TM	B1667	VARIAN	12635A	4A/SQ CM	6,444.6	40,288.6	39,654.4	634.2	7,078.8	3.5mA
27	TM	B1671	VARIAN	12637A	4A/SQ CM	5,394.4	49,573.7	48,887.7	686.0	6,080.4	1.1mA
28	TM	B1672	VARIAN	12632B	4A/SQ CM	7,064.0	52,124.3	51,438.6	685.7	7,749.7	.25mA
29	RV	A002	VARIAN	12638B	4A/SQ CM	2,195.6	48,107.3	47,473.1	634.2	2,829.8	.1ma
30	RV	A003	VARIAN	12641A	2A/SQ CM	2,452.5	30,470.8	29,836.0	634.8	3,087.3	.5mA
31	RV	A005	VARIAN	12643A	2A/SQ CM	2,768.8	28,426.1	27,739.8	686.3	3,455.1	.6mA
32	RV	A006	VARIAN	12640A	4A/SQ CM	2,364.6	47,734.1	47,048.2	685.9	3,050.5	1.0mA
33	RV	A007	VARIAN	12640B	4A/SQ CM	2,211.2	46,000.8	45,366.2	634.6	2,845.8	.5mA
34	RV	A008	VARIAN	12641B	2A/SQ CM	2,508.1	33,000.1	32,313.6	686.5	3,194.6	.4mA
35	RV	A009	VARIAN	12643B	2A/SQ CM	2,433.2	30,640.7	29,954.2	686.5	3,119.7	.4mA

5.0 REFERENCES

1) A.F. Morreall, B.R. Kwasowsky, D.T. Bussey, "RADC Cathode Test Life Test Program", RADC-TR-83-17. In house report January 1983

2) Cober Electronics, Inc. "Technical Manual", Model 3399 Cathode Life Test Station, November 1981

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