

SOUTHWEST RESEARCH INSTITUTE
Department of Quality Assurance
Calibration Laboratory • 522-5215

WORK ORDER

CERTIFICATE # 22862 ASSET # 001044 DATE 30 Sept. 96

ITEM DATA:

Manufacturer Kelly Model 67
Description Programmable electrometer Serial # 537418
Accessories cable (frisk)

ACTION REQUESTED cal

CUSTODIAN Darrell Dunn Div. 20

Turned in by: _____ Phone 0090

CHARGE # 20-5700-561 Date Required _____

INSTRUMENT USED ON: NUCLEAR DOD NASA GLP SPPE
 OTHER _____

COPY OF CALIBRATION CERTIFICATE Yes No

CONDITION RECEIVED: _____ Out of tolerance, repaired to specifications
_____ In tolerance, minor adjustments/repairs made
_____ In tolerance, no adjustments/repairs
_____ Out of tolerance, adjusted to specifications
_____ Received into system, introduced or reactivated
_____ Calibration interval
_____ Reliability code

ACTION TAKEN: (Calibration/Repair/Parts) ST # 288059 to Nothe 9/30

CAL ENVIRONMENT:
Temperature _____ °F Humidity _____ %RH

CALIBRATED/REPAIRED:
By _____ Cal Procedure _____
Date _____ Accuracy _____
Cal Interval _____ Time to complete:
Next Cal due _____ Cal _____ Repair _____
Standards used (Asset#) _____

DATE COMPLETED _____
DATE PICKED UP 10/11/96 PICKED UP BY [Signature]

22862



Rothe Development Inc.

Metrology Services Division

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 210-648-3131 FAX 210-648-4091

Certificate of Calibration

45244

CAL DATE: 10/04/96

DUE DATE: 10/04/97

ISSUED TO: Southwest Research Institute (30)
6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78234
684-5111 * 2702

MFG Keithley

MODEL 617

SERIAL # 537418

CONTROL: 114 - 15981

TECHNICIAN #: 4

SPECIFICATIONS: MFG

PROCEDURE: MFG

WORK ORDER #: 55953

CUSTOMER PO #: 02127/ST288059/20-0760

TYPE Programmable Electrometer

RECEIVED IN-SPECS
OUT-OF-SPECS

All Calibration measurements performed at ROTHE DEVELOPMENT INC. METROLOGY SERVICES meet the requirements of MIL-STD-45662A, and are traceable to the National Institute of Standards and Technology through Primary NIST Calibration or Secondary Calibration performed by other Metrological facilities. Ambient conditions: Temperature 73°F, Relative Humidity 34%

Test Report Number and Calibration Standards Used

Ref #	Model #	Mfgr	Serial #	Description	Cal Date	Int	Cal Exp
TR 20	5700A	FLUKE	4605002	CALIBRATOR	09/03/96	3	12/03/96
TR 75	NMN	JRL	75	RESISTANCE BOX	08/30/96	12	08/30/97
TR 235	6500A	GUILDLINE	59660	TERAOhMETER	09/17/96	12	09/17/97

----- Test Report Numbers -----
 DCV FLUKE CERT# DH70
 ACV FLUKE CERT# DP30
 QMM NIST TEST# 255975
 NIST TEST# 8980
 Hz WWVB Transmission

INSPECTED BY
COMMENTS:

Jose A Mendez

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: SWRI
 WO NUMBER: 55953
 SERIAL: 537418
 CUST ID: _____

DATE: 4 Oct 96
 TECH: PJS
 INST NO: 15981

CALIBRATION DATA TAKEN

INCOMING ✓
 OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
 OUT OF TOLERANCE _____

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C READING +34

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	<u>.000</u>	+0.001
	19 mA	18.970	<u>18.999</u>	19.030
2 mA	1.9 mA	1.8967	<u>1.8998</u>	1.9033
200 uA	190 uA	189.70	<u>190.01</u>	190.30
20 uA	19 uA	18.970	<u>19.002</u>	19.030

RANGE	NOMINAL	ACTUAL	TOLERANCE	P / F	READING
2 uA	1.9 uA	<u>1.9000 uA</u>	±.15% +4C	P / F	<u>1.8997</u>
200 nA	190 nA	<u>190.00 nA</u>	±.25% +1C	P / F	<u>190.01</u>
20 nA	19 nA	<u>19.000 nA</u>	±.25% +1C	P / F	<u>19.004</u>
2 nA	1.9 nA	<u>1.9000 nA</u>	±.25% +5C	P / F	<u>1.8998</u>
200 pA	190 pA	<u>190.00 pA</u>	±1.6% +1C	P / F	<u>190.09</u>
20 pA	19 pA	<u>19.000 pA</u>	±1.6% +7C	P / F	<u>19.002</u>
2 pA	1.9 pA	<u>1.9000 pA</u>	±1.6% +66C	P / F	<u>1.9025</u>

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.995	<u>.999</u>	1.005

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	<u>189.99</u>	190.13
	-190 mV	189.87	<u>189.99</u>	190.13
2 V	+1.9 V	1.8990	<u>1.9001</u>	1.9010
	-1.9 V	1.8990	<u>1.9001</u>	1.9010
20 V	+19 V	18.990	<u>19.000</u>	19.010
	-19 V	18.990	<u>19.000</u>	19.010
200 V	+190 V	189.86	<u>190.00</u>	190.14
	-190 V	189.86	<u>190.01</u>	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE		READING
2 KΩ (19)	<u>1.8999 K</u>	±0.2% +4C	P / F	<u>1.8998</u>
20 KΩ	<u>18.999 K</u>	±0.15% +1C	P / F	<u>18.999</u>
200 KΩ	<u>190.00 K</u>	±0.25% +1C	P / F	<u>189.98</u>
2 MΩ	<u>1.9000 M</u>	±0.25% +1C	P / F	<u>1.8997</u>
20 MΩ	<u>18.997 M</u>	±0.25% +1C	P / F	<u>18.997</u>
200 MΩ (1)	<u>99.99 M</u>	±0.3% +1C	P / F	<u>99.98</u>
2 GΩ	<u>1.0019 G</u>	±1.5% +1C	P / F	<u>1.0026</u>
20 GΩ	<u>9.978 G</u>	±1.5% + 1C	P / F	<u>9.980</u>
200 GΩ	<u>98.85 G</u>	±1.5% + 1C	P / F	<u>98.49</u>

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	<u>+0.032</u>	+0.050
+01.00 V	+0.948	<u>1.015</u>	+1.052
-01.00 V	-0.948	<u>.971</u>	-1.052
+10.00 V	+9.930	<u>10.013</u>	+10.07
-10.00 V	-9.930	<u>9.973</u>	-10.07
+25.00 V	+24.90	<u>25.019</u>	+25.10
-25.00 V	-24.90	<u>24.975</u>	-25.10

+50.00 V
-50.00 V
+100.00 V
-100.00 V

+49.85	<u>50.025</u>	+50.15
-49.85	<u>49.983</u>	-50.15
+99.75	<u>100.042</u>	+100.25
-99.75	<u>100.012</u>	-100.25



Rothe Development, Inc.

4614 SINCLAIR RD. SAN ANTONIO, TEXAS 78222-2099

210-648-3131 FAX: 210-648-4091

METROLOGY SERVICES DIVISION
PRECISION MEASUREMENT EQUIPMENT LABORATORY
TRACEABLE TO NIST

CHARGE # 107

CONTROL # 114 - 15981

WORK ORDER # 55953

CUSTOMER	RECEIVED FROM	Southwest Research Institute (30)	DATE	10/01/96	ITEM	MFG	Keithley
	ADDRESS	6220 Culebra, Bldg. 64/Division 30 San Antonio, TX 78284	PHONE#	684-5111 * 2702		MODEL	617
	CONTACT (NAME)	Mr. Jim Patterson	FAX#	522-3692		SERIAL #	537418
	PURCHASE ORDER #	02127/ST288059/20-0760				TYPE	Programmable Electrometer
	CUSTOMER COMMENTS	N/T BEFORE & AFTER DATA OUT OF SPEC ITEM				ACCES. RCVD.	Lead

- REPAIR
- OPERATIONAL CHECK
- CALIBRATION

CALIBRATION DATE 4 Oct 96
DATE DUE 4 Oct 97

CALIBRATION INTERVAL
12 mo.

- RECEIVED IN SPECS.
- RECEIVED INOPERATIVE
- RECEIVED OUT OF SPECS.

CKT REF #	QTY.	MFG PART #	DESCRIPTION	COST	ROTHER TECH.	OUR P.O. #
					PJS	
					REPAIR LABOR HRS.	SERVICE CODE
						J
					PARTS TOTAL	
					REPAIR LABOR	
					SHIPPING	
					TEAR DOWN CHARGE	
					CALIBRATION	100.00
					TAX	
					TOTAL	100.00

TR #'s 20, 75, 235

COMMENTS

WORK PERFORMED: Cal Data Taken -

Cite

TEMP 73 °F SPECS: MFG RDI
 R.H. 34 % PROCEDURE: MFG RDI OTHER

RDI 2002
 SHIP VIA: _____ DATE: _____ RECEIVED BY: _____

SOUTHWEST RESEARCH INSTITUTE
Department of Quality Assurance
Calibration Laboratory • 522-5215

WORK ORDER

CERTIFICATE # 21163 ASSET # 001044 DATE 13 Oct. 97

ITEM DATA:

Manufacturer Kentley Model 617
Description programmable ohmmeter Serial # 537418
Accessories max cable
ACTION REQUESTED cal # 1600

CUSTODIAN Div. 70, Darrell Dunn

Turned in by: _____ Phone 6090

CHARGE # 70-1102-561 Date Required RUSH

INSTRUMENT USED ON: DOD/NASA NUCLEAR GLP SPPE ISO
 OTHER _____

COPY OF CALIBRATION CERTIFICATE Yes No

NEW WORK Yes No If yes, an evaluation shall be made to verify capabilities.
By _____ Date _____

CONDITION RECEIVED: _____ (F) Out of tolerance, repaired to specifications
_____ (G) In tolerance, minor adjustments/repairs made
_____ (J) In tolerance, no adjustments/repairs
_____ (K) Out of tolerance, adjusted to specifications
_____ (S) Received into system, introduced or reactivated

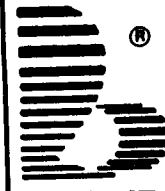
ACTION TAKEN: (Calibration/Repair/Parts) Date Div. 5# 3/1/96 1/13

CAL ENVIRONMENT: Temperature 13 °F Humidity 34 %RH

CALIBRATED/REPAIRED: By Rache Div. San Antonio, TX Cal Procedure ME9
Date 10/23/97 Accuracy ME9
Cal Interval 12 mos Reliability Code: _____
Next Cal due 10/23/98 Cal Time _____ Repair Time _____
Standards used (Asset#) Vendor

DATE COMPLETED 24 Oct. 97
DATE PICKED UP 10/27/97 PICKED UP BY [Signature]

21163



ROTHE DEVELOPMENT, INC.
METROLOGY SERVICES DIVISION
4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 PH:210-648-3131

CERTIFICATE OF CALIBRATION

ISSUED TO: Southwest Research Institute
6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78284
522-5460

(30) MFG: Keithley
MODEL: 617
NOMEN: Programmable Electrometer
S/N: 537418
CUST. ID:

CAL DATE: 10/23/1997
DUE DATE: 10/23/1998

CONTROL NO.: 103 - 15981
TECHNICIAN: 6
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 61919
CUSTOMER P.O.: 02127/ST311616/20-1402561
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12mos.
TEMPERATURE: 73 °F
RELATIVE HUMIDITY: 34 %

DATE RECEIVED: 10/14/1997

COMMENTS:

ATTACHMENTS: CALIBRATION DATA

All Calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI/NC SL Z540-1-1994, ISO/IEC GUIDE 25, and ISO 10012-1, and are traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement(s) does not exceed 25% (TUR_≥4:1) of the instrument specification(s) unless noted in the COMMENTS section.

TR#	MFG	MODEL	SERIAL NO.	DUE DATE
20	FLUKE	5700A	4605002	12/09/1997
231	HP	34401A	3146A45255	02/27/1998
235	GUILDLINE	6500A	59660	05/19/1998

APPROVED BY: *Steve J. Steinhilber*

CMS QCO DATE: 10/23/1997

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: Southwest Research Inst.
 WO NUMBER: 61919
 SERIAL: 537418
 CUST ID: _____

DATE: Oct 23, 97
 TECH: Zm
 INST NO: 5987

CALIBRATION DATA TAKEN

INCOMING ✓
 OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
 OUT OF TOLERANCE _____

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C READING
- .0022

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	<u>0.000</u>	+0.001
	19 mA	18.970	<u>18.999</u>	19.030
2 mA	1.9 mA	1.8967	<u>1.8999</u>	1.9033
200 uA	190 uA	189.70	<u>190.01</u>	190.30
20 uA	19 uA	18.970	<u>19.003</u>	19.030
2 uA	1.9 uA	1.8967	<u>1.8999</u>	1.9033
200 nA	190 nA	189.51	<u>189.78</u>	190.49
20 nA	19 nA	18.951	<u>19.002</u>	19.049
2 nA	1.9 nA	1.8947	<u>1.8998</u>	1.9053
200 pA	190 pA	186.95	<u>190.02</u>	193.05
20 pA	19 pA	18.689	<u>18.990</u>	19.311
2 pA	1.9 pA	1.8630	<u>1.8760</u>	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	<u>9987</u>	1.0051

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	<u>190.01</u>	190.13
	-190 mV	189.87	<u>-189.99</u>	190.13
2 V	+1.9 V	1.8990	<u>1.9002</u>	1.9010
	-1.9 V	1.8990	<u>-1.9002</u>	1.9010
20 V	+19 V	18.990	<u>19.000</u>	19.010
	-19 V	18.990	<u>-19.000</u>	19.010
200 V	+190 V	189.86	<u>190.01</u>	190.14
	-190 V	189.86	<u>-190.02</u>	190.14

RESISTANCE ACCURACY

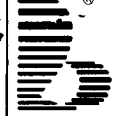
RANGE	ACUTAL INPUT	TOLERANCE	P / F	READING
2 KΩ (19)	<u>1.8999</u>	±0.2% +4C	P / F	<u>1.8997</u>
20 KΩ	<u>18.999</u>	±0.15% +1C	P / F	<u>18.999</u>
200 KΩ	<u>189.99</u>	±0.25% +1C	P / F	<u>189.97</u>
2 MΩ	<u>1.9000</u>	±0.25% +1C	P / F	<u>1.8997</u>
20 MΩ	<u>18.997</u>	±0.25% +1C	P / F	<u>18.997</u>
200 MΩ (1)	<u>99.99</u>	±0.3% +1C	P / F	<u>99.97</u>
2 GΩ	<u>1.0020</u>	±1.5% +1C	P / F	<u>1.0021</u>
20 GΩ	<u>9.975</u>	±1.5% + 1C	P / F	<u>9.977</u>
200 GΩ	<u>98.75</u>	±1.5% + 1C	P / F	<u>98.75</u>

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	<u>0.032</u>	+0.050
+01.00 V	+0.948	<u>1.015</u>	+1.052
-01.00 V	-0.948	<u>-.971</u>	-1.052
+10.00 V	+9.930	<u>10.01</u>	+10.07
-10.00 V	-9.930	<u>-9.973</u>	-10.07
+25.00 V	+24.90	<u>25.02</u>	+25.10
-25.00 V	-24.90	<u>-24.98</u>	-25.10

+50.00 V
-50.00 V
+100.00 V
-100.00 V

+49.85	<u>50.00</u>	+50.15
-49.85	<u>-49.98</u>	-50.15
+99.75	<u>100.04</u>	+100.25
-99.75	<u>-100.01</u>	-100.25



CHARGE # 107

CONTROL # 103 - 15981

WORK ORDER # 61919

U
S
T
O
M
E
R

RECEIVED FROM: Southwest Research Institute

(30) DATE: 10/14/97

MFG: Keithley

PHONE #: 522-5460

MODEL: 617

ADDRESS: 6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78284

FAX #: 522-3692

NOMEN: Programmable Electrometer

S/N: 537418

I
T
E
M

CUST ID:

ACCESS

RCVD: *Lead*

CONTACT NAME: Mr. Mark Romero

PURCHASE ORDER #: 02127/ST311616/20-1402561

CUSTOMER COMMENTS/REQUIREMENTS: N/T BEFORE & AFTER DATA OUT OF SPEC ITEM

OUR PO:

DATA:

RECEIVED:

- IN TOLERANCE
- OUT OF TOLERANCE
- INOPERATIVE

RETURNED:

- IN TOLERANCE
- LIMITED CALIBRATION
- REPAIR ONLY
- NO ACTION

Date

CALIBRATION INTERVAL: 12mos.

CAL DATE: *Oct 23 97*
DUE DATE: *Oct 23 98*

CAL'D-AT:

- RDMSD
- ON-SITE
- SUB

ENVIRONMENTAL

CONDITIONS:

73 °F
34 %RH

SPECIFICATIONS:

- MFG
- RDMSD: _____
- OTHER: _____

PROCEDURE:

- MFG
- RDMSD: _____
- OTHER: _____

RDMSD

TECH:

m2

SERVICE

CODE:

J

FAULT/SYMPTOM:

WORK PERFORMED:

Calibrated

TR#'S:

20, 231, 235

LIMITED CALIBRATION:

COMMENTS:

CKT REF	QTY	PART #	DESCRIPTION	COST	REPAIR LABOR HOURS: _____
					PARTS TOTAL
					REPAIR LABOR
					SHIPPING
					TEAR DOWN
					CHARGE
					CALIBRATION 100.00
					TAX 0.0000
					TOTAL 100.00

SHIP VIA:

DATE:

RDMSD 2002
08/97

RCVD BY

(SIGNED): _____

(PRINTED): _____

SOUTHWEST RESEARCH INSTITUTE
Department of Quality Assurance
Calibration Laboratory • 522-5215

WORK ORDER

CERTIFICATE # 3711 ASSET # 1044 DATE 710998

ITEM DATA:

Manufacturer Kentley Model 617
Description Programmable Electronics Serial # 537418
Accessories trace cable

ACTION REQUESTED RUSH - ASAP!

CUSTODIAN Durrell Dunn

Turned in by: 70-1902-571 Phone 6090

CHARGE # 70-1902-571 Date Required _____

INSTRUMENT USED ON: (DOD/NASA) (NUCLEAR) (GLP) (SPPE) (ISO)
 OTHER all

COPY OF CALIBRATION CERTIFICATE (Yes) (No)

NEW WORK Yes No If yes, an evaluation shall be made to verify capabilities.

By _____ Date _____

Work involves proprietary/confidential information or equipment (Yes) (No)

CONDITION RECEIVED: _____ (F) Out of tolerance, repaired to specifications
_____ (G) In tolerance, minor adjustments/repairs made
_____ (J) In tolerance, no adjustments/repairs
 (K) Out of tolerance, adjusted to specifications
_____ (S) Received into system, introduced or reactivated

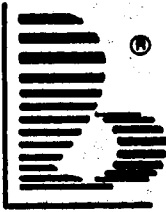
ACTION TAKEN: (Calibration/Repair/Parts) 10/23 Radio Div. ST# 336965

CAL ENVIRONMENT:
Temperature 72 °F Humidity 36 %RH

CALIBRATED/REPAIRED:
By Donna Dev. San Antonio, tx Cal Procedure MTG
Date 10/20/98 Accuracy MTG
Cal Interval 12 mos Reliability Code: 21
Next Cal due 10/30/99 Cal Time _____ Repair Time _____
Standards used (Asset#) Vendor

DATE COMPLETED 02 Nov 98
DATE PICKED UP 11/4/98 PICKED UP BY Durrell Dunn

3711



CERT. NUMBER: 55080

ROTHE DEVELOPMENT, INC.
METROLOGY SERVICES DIVISION
4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 PH:210-648-3131

CERTIFICATE OF CALIBRATION

ISSUED TO: Southwest Research Institute
6220 Culebra, Bldg. 64/Division 30
San Antonio, TX 78284
522-5460

(30) MFG: Keithley
MODEL: 617
NOMEN: Programmable Electrometer
S/N: 537418
CUST. ID:

CAL DATE: 10/30/1998
DUE DATE: 10/30/1999

CONTROL NO.: 103 - 15981
TECHNICIAN: 9
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 68351
CUSTOMER P.O.: 02127/ST336965/20-1402571
RECEIVED CONDITION: OUT OF TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12mos.
TEMPERATURE: 72 °F
RELATIVE HUMIDITY: 36 %

DATE RECEIVED: 10/26/1998

COMMENTS:

ATTACHMENTS: CALIBRATION DATA

All Calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI/NCCL Z540-1-1994, ISO/IEC GUIDE 25, and ISO 10012-1, and are traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement(s) does not exceed 25% (TUR_>4:1) of the instrument specification(s) unless noted in the COMMENTS section.

TR#	MFG	MODEL	SERIAL NO.	DUE DATE
182	GEN RAD	1433-H	32941	08/04/1999
20	FLUKE	5700A/EP	4605002	12/25/1998
258	FLUKE	5725A	6585002	12/25/1998
235	GUILDLINE	6500A	59660	06/23/1999
231	HP	34401A	3146A45255	02/25/1999

APPROVED BY:

Peter J. Stemmer

CMS

QCO

DATE: 11/02/1998

RDMSD 1001
08/97

This certificate may not be reproduced, except in full, without written approval of Rothe Development, Inc. Metrology Services Division.

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: Southwest Research
 WO NUMBER: 68351
 SERIAL: 537418
 CUST ID: _____

DATE: 27 Oct 98
 TECH: MH
 INST NO: 15981

CALIBRATION DATA TAKEN

INCOMING ✓
 OUTGOING _____

CONDITION OF EQUIPMENT

IN TOLERANCE _____
 OUT OF TOLERANCE ✓ *

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C READING .0103 *

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	<u>0.000</u>	+0.001
	19 mA	18.970	<u>18.985</u>	19.030
2 mA	1.9 mA	1.8967	<u>1.8994</u>	1.9033
200 uA	190 uA	189.70	<u>190.01</u>	190.30
20 uA	19 uA	18.970	<u>19.004</u>	19.030
2 uA	1.9 uA	1.8967	<u>1.8999</u>	1.9033
200 nA	190 nA	189.51	<u>189.96</u>	190.49
20 nA	19 nA	18.951	<u>18.984</u>	19.049
2 nA	1.9 nA	1.8947	<u>1.8994</u>	1.9053
200 pA	190 pA	186.95	<u>190.80</u>	193.05
20 pA	19 pA	18.689	<u>19.770</u>	19.311*
2 pA	1.9 pA	1.8630	<u>2.295</u>	1.9370 *

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	<u>1.0002</u>	1.0051

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	<u>190.01</u>	190.13
	-190 mV	189.87	<u>189.99</u>	190.13
2 V	+1.9 V	1.8990	<u>1.9002</u>	1.9010
	-1.9 V	1.8990	<u>1.9003</u>	1.9010
20 V	+19 V	18.990	<u>19.000</u>	19.010
	-19 V	18.990	<u>19.001</u>	19.010
200 V	+190 V	189.86	<u>190.01</u>	190.14
	-190 V	189.86	<u>190.02</u>	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE	READING
2 K Ω (19)	<u>1.8999</u>	$\pm 0.2\%$ +4C	P / F <u>1.8999</u>
20 K Ω	<u>18.999</u>	$\pm 0.15\%$ +1C	P / F <u>18.999</u>
200 K Ω	<u>189.99</u>	$\pm 0.25\%$ +1C	P / F <u>189.97</u>
2 M Ω	<u>1.9000</u>	$\pm 0.25\%$ +1C	P / F <u>1.8996</u>
20 M Ω	<u>18.997</u>	$\pm 0.25\%$ +1C	P / F <u>18.998</u>
200 M Ω (1)	<u>100.08</u>	$\pm 0.3\%$ +1C	P / F <u>100.04</u>
2 G Ω	<u>1.0085</u>	$\pm 1.5\%$ +1C	P / F <u>1.0052</u>
20 G Ω	<u>9.979</u>	$\pm 1.5\%$ + 1C	P / F <u>9.990</u>
200 G Ω	<u>98.81</u>	$\pm 1.5\%$ + 1C	P / F <u>98.51</u>

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	<u>.032</u>	+0.050
+01.00 V	+0.948	<u>1.015</u>	+1.052
-01.00 V	-0.948	<u>.971</u>	-1.052
+10.00 V	+9.930	<u>10.02</u>	+10.07
-10.00 V	-9.930	<u>9.973</u>	-10.07
+25.00 V	+24.90	<u>25.02</u>	+25.10
-25.00 V	-24.90	<u>24.97</u>	-25.10

+50.00 V
-50.00 V
+100.00 V
-100.00 V

+49.85	<u>50.02</u>	+50.15
-49.85	<u>49.98</u>	-50.15
+99.75	<u>100.04</u>	+100.25
-99.75	<u>100.01</u>	-100.25

ROTHE DEVELOPMENT METROLOGY SERVICES

CALIBRATION DATA: KEITHLEY 617 ELECTROMETER

CUSTOMER: Southwest Research
 WO NUMBER: 68351
 SERIAL: 537418
 CUST ID: _____

DATE: 30 Oct 98
 TECH: MN
 INST NO: 15981

CALIBRATION DATA TAKEN

INCOMING _____
 OUTGOING ✓

CONDITION OF EQUIPMENT

IN TOLERANCE ✓
 OUT OF TOLERANCE _____

INPUT CURRENT VERIFICATION

SET-UP: 2PA RANGE, INPUT CAPPED, TOLERANCE <66 C READING .0017

CURRENT ACCURACY

RANGE	INPUT	MIN	READING	MAX
20 mA	ZERO CHECK	-0.001	<u>0.000</u>	+0.001
	19 mA	18.970	<u>18.990</u>	19.030
2 mA	1.9 mA	1.8967	<u>1.8995</u>	1.9033
200 uA	190 uA	189.70	<u>190.02</u>	190.30
20 uA	19 uA	18.970	<u>19.003</u>	19.030
2 uA	1.9 uA	1.8967	<u>1.8999</u>	1.9033
200 nA	190 nA	189.51	<u>189.97</u>	190.49
20 nA	19 nA	18.951	<u>18.957</u>	19.049
2 nA	1.9 nA	1.8947	<u>1.8960</u>	1.9053
200 pA	190 pA	186.95	<u>190.48</u>	193.05
20 pA	19 pA	18.689	<u>19.190</u>	19.311
2 pA	1.9 pA	1.8630	<u>1.9250</u>	1.9370

COULOMB ACCURACY

RANGE	INPUT	MIN	READING	MAX
2nC	1V / 1000pF	0.9949	<u>1.0004</u>	1.0051

DC VOLTAGE ACCURACY

RANGE	INPUT	MIN	READING	MAX
200 mV	+190 mV	189.87	<u>190.00</u>	190.13
	-190 mV	189.87	<u>189.99</u>	190.13
2 V	+1.9 V	1.8990	<u>1.9002</u>	1.9010
	-1.9 V	1.8990	<u>1.9002</u>	1.9010
20 V	+19 V	18.990	<u>19.000</u>	19.010
	-19 V	18.990	<u>19.001</u>	19.010
200 V	+190 V	189.86	<u>190.01</u>	190.14
	-190 V	189.86	<u>190.02</u>	190.14

RESISTANCE ACCURACY

RANGE	ACUTAL INPUT	TOLERANCE	READING
2 KΩ (19)	<u>1.8999</u>	±0.2% +4C	P / Ω <u>1.8998</u>
20 KΩ	<u>18.999</u>	±0.15% +1C	P / Ω <u>18.999</u>
200 KΩ	<u>189.99</u>	±0.25% +1C	P / Ω <u>189.99</u>
2 MΩ	<u>1.9000</u>	±0.25% +1C	P / Ω <u>1.8996</u>
20 MΩ	<u>18.997</u>	±0.25% +1C	P / Ω <u>18.998</u>
200 MΩ (1)	<u>100.00</u>	±0.3% +1C	P / Ω <u>100.00</u>
2 GΩ	<u>1.0019</u>	±1.5% +1C	P / Ω <u>1.0020</u>
20 GΩ	<u>9.979</u>	±1.5% + 1C	P / Ω <u>9.966</u>
200 GΩ	<u>98.81</u>	±1.5% + 1C	P / Ω <u>98.33</u>

OUTPUT VOLTAGE SOURCE ACCURACY

OUTPUT SETTING	MIN	READING	MAX
00.00V	-0.050	<u>- .032</u>	+0.050
+01.00 V	+0.948	<u>1.015</u>	+1.052
-01.00 V	-0.948	<u>.971</u>	-1.052
+10.00 V	+9.930	<u>10.013</u>	+10.07
-10.00 V	-9.930	<u>9.973</u>	-10.07
+25.00 V	+24.90	<u>25.018</u>	+25.10
-25.00 V	-24.90	<u>24.974</u>	-25.10

+50.00 V
-50.00 V
+100.00 V
-100.00 V

+49.85	<u>50.023</u>	+50.15
-49.85	<u>49.982</u>	-50.15
+99.75	<u>100.038</u>	+100.25
-99.75	<u>100.009</u>	-100.25

SOUTHWEST RESEARCH INSTITUTE
Department of Quality Assurance
Calibration Laboratory • 522-5215

WORK ORDER

WORK ORDER # 36850 ASSET # 001011 DATE 17 Nov 99

ITEM DATA:

Manufacturer Kentley Model 617
Description programmable electrometer Serial # 537418
Accessories _____

ACTION REQUESTED Cal

CUSTODIAN Div. 20, Darrell Dunn

Turned in by: _____ Phone 6090

CHARGE # 10.04 Date Required _____

INSTRUMENT USED ON: (DOD/NASA) (NUCLEAR) (GLP) (SPPE) (ISO)
 OTHER _____

COPY OF CALIBRATION CERTIFICATE (Yes) (No)

NEW WORK Yes No If yes, an evaluation shall be made to verify capabilities.

By MAP Date 11.17.99

Work involves proprietary/confidential information or equipment (Yes) (No)

CONDITION RECEIVED: _____ Out of tolerance
 In tolerance
_____ Damaged (Contact customer)
_____ Contact _____ Date _____
_____ Received into system, introduced or reactivated

ACTION TAKEN: (Calibration/Repair/Parts) 11/19 Rothe Dev. ST# 359500

CAL ENVIRONMENT:
Temperature 72 °F Humidity 33 %RH

CALIBRATED/REPAIRED:
By Rothe Dev. San Antonio, TX Cal Procedure MEG
Date 12-26-99 Accuracy MEG Specs
Cal Interval 12 mos Reliability Code _____
Next Cal Due 12-26-00 Cal Time _____ Repair Time _____
Standards used (Asset #) Vendor

DATE COMPLETED 21 Dec. 99

DATE PICKED UP 12/31/99 PICKED UP BY Darrell Dunn

36850



CERT. NUMBER:
15981:946195283

ROTHE DEVELOPMENT, INC.
METROLOGY SERVICES DIVISION

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 PH:210-648-3131

CERTIFICATE OF CALIBRATION

ISSUED TO: Southwest Research Institute (30) 6220 Culebra San Antonio, TX 78284	MFG: Keithley MODEL: 617 NOMEN: Programmable Electr S/N: 537418 CUST. ID:	CAL DATE: 12/26/1999 DUE DATE: 12/26/2000
--	---	--

CONTROL NO.: 103 - 15981
 TECHNICIAN: 4
 SPECIFICATIONS: MFG
 PROCEDURE: MFG
 WORK ORDER: 75612
 CUSTOMER P.O.: 02127/ST359500/20.00760.
 RECEIVED CONDITION: IN TOLERANCE
 RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
 CALIBRATION INTERVAL: 12Mo.
 TEMPERATURE: 72.0 °F
 RELATIVE HUMIDITY: 33 %

DATE RECEIVED: 11/22/1999

COMMENTS:

ATTACHMENTS:

All Calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI/NCCL Z540-1-1994, ISO/IEC GUIDE 25, and ISO 10012-1, and are traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement(s) does not exceed 25% (TUR \geq 4:1) of the instrument specification(s) unless noted in the COMMENTS section.

TR#	MFG	MODEL	SERIAL NO.	DUE DATE
20	FLUKE	5700A/EP	4605002	3/23/2000
258	FLUKE	5725A	6585002	3/23/2000
75	JRL	NMN	75	11/15/2000
235	GUILDLINE	6500A	59660	10/26/2000
186	GEN RAD	1689	7241583008	8/17/2000

APPROVED BY:

CMS

QCO

DATE:

12/27/1999

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by RCRUZ at 3:51:37PM on 1/19/01

||||| ||||| ||||| ||||| ||||| ||||| |||||

Work Order 444042123

Arrived 1/19/01

Asset No. 001044 Manufacturer KEITHLEY

Model 617

Instrument Type/Class ELECTROMETER

Serial No. 537418

Accessory No.

Calibration Procedure VENDOR

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel. 6090

Charge/Project No. 20.00751.006

Delivered By / Telephone

IN4REP

Special Instructions For Repair + Calibration, Fix alligator clips

WORK NOTES

Date	Hours	Remarks/Notes
<u>1-23-01</u>		<u>Roche P.O.C. Lori Cal. #110 ee will call</u>
		<u>w/repair estimate</u>
<u>1-24-01</u>		<u>Sent to vendor</u>

REPAIR PARTS

Date	Hours	Part Name	Part Number	Failure Description	Cost

WORK SUMMARY

Failure Description _____

Repair Action _____

Calibration Procedure None Temp 73 F Hum. 33 %

Tech Roche Dev Totals Cal Hours _____ Repair Hours _____ Parts Cost _____

Standards Used Vendor

Date Picked Up 03/16/01

Picked Up By [Signature]

444042123

CERT. NUMBER:
15981:982858940

ROTHE DEVELOPMENT, INC.
METROLOGY SERVICES DIVISION

4614 SINCLAIR RD., SAN ANTONIO, TEXAS 78222 PH:210-648-3131

CERTIFICATE OF CALIBRATION

ISSUED TO: Southwest Research Institute MFG: Keithley
(30) MODEL: 617 CAL DATE: 2/22/2001
6220 Culebra NOMEN: PROG ELECTROMETER DUE DATE: 2/22/2002
San Antonio, TX 78284 S/N: 537418
CUST. ID:

CONTROL NO.: 103 - 15981
TECHNICIAN: 7
SPECIFICATIONS: MFG
PROCEDURE: MFG
WORK ORDER: 002009951
CUSTOMER P.O.: 01571R/ST374817/20.00860
RECEIVED CONDITION: IN TOLERANCE
RETURNED CONDITION: IN TOLERANCE

CALIBRATION PERFORMED AT: RDMSD
CALIBRATION INTERVAL: 12Mo.
TEMPERATURE: 73.0 °F
RELATIVE HUMIDITY: 33 %
DATE RECEIVED: 1/25/2001

COMMENTS:

ATTACHMENTS:

All Calibrations performed at Rothe Development, Inc. Metrology Services Division meet the requirements of ANSI/NCCL Z540-1-1994, ISO/IEC GUIDE 25, and ISO 10012-1, and are traceable to the National Institute of Standards and Technology. The collective uncertainty of the measurement(s) does not exceed 25% ($TUR \geq 4:1$) of the instrument specification(s) unless noted in the COMMENTS section.

TR#	MFG	MODEL	SERIAL NO.	DUE DATE
20	FLUKE	5700A/EP	4605002	3/22/2001
258	FLUKE	5725A	6585002	3/22/2001
75	JRL	NMN	75	1/22/2002
235	GUILDLINE	6500A	59660	11/1/2001
186	GEN RAD	1689	7241583008	8/31/2001

APPROVED BY: Will R Wright

CMS

QCO

DATE:

2/22/2001

**SOUTHWEST RESEARCH INSTITUTE
CALIBRATION LABORATORY
MEMORANDUM**

February 28, 2001

To: DARRELL DUNN DIV20 B57

From: Walt Hill, Supervisor *WH*
Institute Calibration Laboratory

Subject: Calibration by an approved supplier

Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 537418
Asset Number: 001044
Work Order Number: 444042123
Date Calibrated: February 22, 2001
Remarks: ROTHE CERTIFICATE NO.: 15981:982858940.

Supplier: ROTHE DEVELOPMENT, INC., SAN ANTONIO, TX

The above item was sent to an approved supplier who is listed on the SwRI Approved Suppliers List (ASL). This supplier is qualified to supply a product or service in support of project activities that require the use of approved suppliers. Please notify the Institute Calibration Laboratory, extension 5215, of any discrepancies with the item or calibration documentation.

Attachment(s) 1

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

RUSH

Received by RCRUZ, 3/6/02 3:12:07PM

Arrived 3/6/02

Work Order **444047544**

Asset No. 001044 Manufacturer KEITHLEY

Model 617

Equipment Type ELECTROMETER

Serial No. 537418

Accessory No.

Interval 12 M

Calibration Procedure MFG

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel 6090

QUEUE

Special Instructions _____

5448
5446

Notify before adjustments or repairs. Provide data with certificate Certificate Typ _____

Charge/Project No. 00751.006 1.20

Requester / Telephone _____

This information is correct for the work requested.

WORK NOTES

Date	Hours	Remarks/Notes
<u>3/11</u>	<u>3</u>	<u>cal</u>

Date	Hours	Part Name	Part Number	Failure Description	Cost

WORK SUMMARY

Failure Description _____

Repair Action _____

Tech BLT Cal Hrs. 3 Repair Hrs _____ Parts Cost _____ Temp _____ F Hum. _____ %

Standards Used 182 1505 3121 101 185

Date Picked Up 3/11/02

Picked Up By Darrell Dunn

47544

Work Order: 444047544	Mfr. KEITHLEY	Technician: BLT
Asset No. 001044	Model: 617	Cal Date: March 8, 2002
Serial No. 537418	Type: Programmable Electrometer	Condition: As Found

Test Instrument (TI) Characteristics	Performance Specifications	Test Method
DC Voltage	Range: 0 - 200 Volts Accuracy: 0.05% - 0.7%	Compared to a DC Voltage Standard
Voltage Source	Range: 0 - 102 VDC Accuracy: 0.2%	Compared to a Precision DMM
DC Current	Range: 0 - 20mA Accuracy: 0.15% - 1.6%	Compared to a DC Current Standard
Resistance	Range: 0 - 200GΩ Accuracy: 0.2% - 1.5%	Compared to a Resistance Standard
Coulombs	Range: 0 - 20nC Accuracy: 0.4%	Compared to a Capacitance Standard

DC CURRENT CALIBRATION				
Range	Test Point	Readings	Expected Limits	Uncertainty
20mA	ZERO	0	-0.001 to 0.001	
20mA	19mA	19.000	18.970 to 19.030	
2mA	1.9mA	1.8996	1.8967 to 19.033	
200uA	10kΩ @ 1.9V	189.99	189.70 to 190.30	
20uA	100kΩ @ 1.9V	19.004	18.970 to 19.030	
2uA	1MΩ @ 1.9V	1.8990	1.8967 to 1.9033	
200nA	10MΩ @ 1.9V	189.91	189.51 to 190.49	
20nA	100MΩ @ 1.9V	18.984	18.951 to 19049	
2nA	100MΩ @ 190mV	1.8970	1.8947 to 1.9053	
200pA	100MΩ @ 1.9V	189.75	1.8967 to 1.9033	

COULOMBS CALIBRATION				
Range	Test Point	Readings	Expected Limits	Uncertainty
20nC	19.000nC	19.048	18.923 to 19.077	

DC VOLTAGE CALIBRATION				
Range	Test Point VDC	Readings	Expected Limits	Uncertainty
200mV	0.19	189.98	189.86 to 190.14	
2V	0.4	0.400	0.3997 to 0.4003	
	0.8	0.8001	0.7995 to 0.8005	
	1.2	1.2001	1.1993 to 1.2007	
	1.6	1.6002	1.5991 to 1.6009	
	1.9	1.9002	1.8989 to 1.9011	
20V	19	18.999	18.989 to 19.011	
200V	190	190.00	189.86 to 190.14	

RESISTANCE				
Range	Test Point	Readings	Expected Limits	Uncertainty
20GΩ	100MΩ	0.100	93 to 107	
20GΩ	100MΩ	100.1	98.4 to 101.6	
200MΩ	100MΩ	100.01	99.69 to 100.31	
20MΩ	10MΩ	10.004	9.974 to 10.026	
2MΩ	1MΩ	.9995	0.9974 to 1.0026	
200kΩ	100kΩ	99.98	99.74 to 100.26	
20kΩ	10kΩ	10.000	9.984 to 10.016	
2kΩ	1kΩ	1.0004	0.9979 to 1.00211	

DC OUTPUT VOLTAGE CALIBRATION				
Range	Test Point VDC	Readings	Expected Limits	Uncertainty
	0.000	30mV	0+/- 50mV	
	10.00V	10.01	9.93 to 10.07	
	50.00V	50.02	49.85 to 50.15	
	100.00V	100.04	99.75 to 100.25	
	-100.00V	-100.01	-100.25 to -99.75	
	-50.00V	-49.98	-50.15 to -49.85	
	-10.00V	-9.972	-10.07 to -9.93	



Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
(210) 522-5215
Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

11 March 2002

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: KEITHLEY 617
Description: ELECTROMETER
Serial Number: 537418
Asset Number: 001044
Work Order Number: 444047544

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. Standards used in this calibration, described in the referenced calibration procedure with associated uncertainties or tolerances, are traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request. This certificate is not to be reproduced, except in full, without the written approval of the Southwest Research Institute Department of Quality Assurance Calibration Laboratory.

The uncertainty of the calibration was sufficient to determine that the item met the manufacturer's published specifications unless stated otherwise below.

Ambient Conditions: Temperature: 72.0 Degrees Fahrenheit Humidity: 42 % RH


Calibration Date: 11 Mar 02 **Calibration Procedure:** MFG

Condition as Received: IN TOLERANCE

Condition as Returned: IN TOLERANCE

Remarks:

Approved by:



Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:



Bob Trollinger, Technician