

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

WORK ORDER

CERTIFICATE # 23525 ASSET # 004828 DATE 02 Dec 96

ITEM DATA:
Manufacturer Blue All that Co. Model BM1000
Description Photo Plotter Recorder Serial # 9E34523
Accessories _____

ACTION REQUESTED _____

CUSTODIAN Carol Dunn, Div. 20 Peter Angell

Turned in by: Carol Dunn Phone 6070

CHARGE # 20-9995-001 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 internal
_____ Realibility code

ACTION TAKEN: (Calibration/Repair/Parts) Calibrated Per Specimen.

CAL ENVIRONMENT:
Temperature 50 °F Humidity 26 %RH

CALIBRATED/REPAIRED:
By [Signature] Cal Procedure [Signature]
Date 3 Dec 96 Accuracy [Signature]
Cal Interval 6 mos Time to complete: _____
Next Cal due 3 Jun 97 Cal 2.5 Repair _____
Standards used (Asset#) 219, 328

DATE COMPLETED 3 Dec 96
DATE PICKED UP 12/4/96 PICKED UP BY [Signature]

23525

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

WORK ORDER

CERTIFICATE # 25533 ASSET # 004028 DATE 23 May 97

ITEM DATA:
Manufacturer Blue M. Electric Company Model BM71110000011
Description Circular chart recorder/multimeter Serial # 91E34523
Accessories _____

ACTION REQUESTED Cal

CUSTODIAN DIV 70, Donnell Gunn Peter Angell

Turned in by: Donnell Gunn Phone 610

CHARGE # 20-5700-S11 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 _____ 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) Collected Per procedure

CAL ENVIRONMENT:
Temperature 74°F Humidity 49%RH

CALIBRATED/REPAIRED:
By Rudolph Cal Procedure CCCP-TC-008
Date 30 May 97 Accuracy 1/2% Spec
Cal Interval 6 Mos Reliability Code: 3
Next Cal due 30 Nov 97 Cal Time 2.0 Repair Time _____
Standards used (Asset#) 219, 328

DATE COMPLETED 30 May 97
DATE PICKED UP 6/4/97 PICKED UP BY [Signature]

25533

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

WORK ORDER

CERTIFICATE # 21800 ASSET # 001828 DATE 21 Dec 97

ITEM DATA:

Manufacturer Blue M Machine Model BM 11000011
Description Hand, stand, Serial # 91K34523
Accessories _____

ACTION REQUESTED cal

CUSTODIAN DVDO, Darrell D

Turned in by: _____ Phone _____

CHARGE # 21401-571 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 _____ 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) calibrated per procedure

CAL ENVIRONMENT:
Temperature 76 °F Humidity 26 %RH

CALIBRATED/REPAIRED:
By J A White Cal Procedure CLCA-TC-008
Date 16 Dec 97 Accuracy 1/2 g
Cal Interval 6 mos Reliability Code: 4
Next Cal due 16 Jun 98 Cal Time 2 Repair Time _____
Standards used (Asset#) 219, 328

DATE COMPLETED 16 Dec 97
DATE PICKED UP 12/17/97 PICKED UP BY [Signature]

21800

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

WORK ORDER

CERTIFICATE # 30697 ASSET # 004828 DATE 8/3/98

ITEM DATA:

Manufacturer BLUE M ELECTRIC Model BM1110000011
Description CHART RECORDER Serial # 91E34523
Accessories SENSOR

ACTION REQUESTED Cal

CUSTODIAN Daniel Duan

Turned in by: Daniel Phone _____

CHARGE # 20-1402-571 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 _____ Date 8/3/98

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) _____

CAL ENVIRONMENT:
Temperature 76 °F Humidity 51 %RH

CALIBRATED/REPAIRED:
By W. Hill Cal Procedure CLCP-TC-008
Date 7 Aug 98 Accuracy mfr Specs
Cal Interval 06 mo Reliability Code: 5
Next Cal due 5 Feb 99 Cal Time 1.0 Repair Time _____
Standards used (Asset#) 219/32B

DATE COMPLETED 7 Aug 98
DATE PICKED UP 8/2/98 PICKED UP BY [Signature]

30697

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

WORK ORDER

CERTIFICATE # 33263 ASSET # 004828 DATE 10 FEB 99

ITEM DATA:

Manufacturer Blue M Electric Model BM-111/2000011
Description Chart recorder Serial # 91E34523
Accessories _____

ACTION REQUESTED Cal

CUSTODIAN Div. 70, David Dunn

Turned in by: _____ Phone 0090

CHARGE # 20. 1402.571 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 MAR Date 02-10-99

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) cal OK

CAL ENVIRONMENT:
Temperature 71 °F Humidity 45 %RH

CALIBRATED/REPAIRED:
By MAR Cal Procedure QCP-TC-008
Date 1 MAR 99 Accuracy ± 1°C
Cal Interval 6 Reliability Code: _____
Next Cal due 1 Sept 99 Cal Time 2 Repair Time _____
Standards used (Asset#) 219 328

DATE COMPLETED 1 MAR 99
DATE PICKED UP 3/4/99 PICKED UP BY [Signature]

33263

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

WORK ORDER

CERTIFICATE # 35952 ASSET # 004828 DATE 09 Sept. 99

ITEM DATA:

Manufacturer Alvo M Electric Model BM711100000011
Description chart recorder Serial # 9E 34523
Accessories _____

ACTION REQUESTED Cal

CUSTODIAN DIV. 20, Danell Dunn

Turned in by: _____ Phone 6090

CHARGE # 20.04 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 mael Date 09-09-99

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) Cal

Previous Cert # 53263

2h

SwRI Cal-Lab By: ju
CAL: 03/01/99 DUE: 09/01/99
AN: 004828 SN: 91E34523
| _____ | _____ | _____ | _____ | _____ | _____ |

CAL ENVIRONMENT:

Temperature 78 °F Humidity 45 %RH

CALIBRATED/REPAIRED:

By [Signature] Cal Procedure CI-9-May 99

Date 9-14-99 Accuracy ±1°C

Cal Interval 6mo Reliability Code: _____

Next Cal due 3-14-00 Cal Time 2h Repair Time _____

Standards used (Asset#) 000219, 000328

DATE COMPLETED 9-14-99

DATE PICKED UP 9/16/99 PICKED UP BY [Signature]

35952

WORK ORDER 37935

Date Received 2/24/00

Asset No. 004828 Manufacturer BLUE M ELECTRIC CO. Model BM711100000011
 Description CHART RECORDER Serial Number 91E34523
 Accessory Received/Required NONE
 Div/CC ID NONE Accessory to Asset No. N/A Accuracy +/- 1 C
 Div/CC DIV20 Location B57 Custodian DARRELL DUNN Tel. 6090
 Charge/Project No. 20.00751.006 Proprietary/Confidential N Date Required ROUTINE
 Work Requested CALIBRATION
 Receiving Inspection O.K.
 Delivered By DARRELL DUNN Tel. _____

WORK HISTORY

Date	Start Time	Stop Time	Notes

SwRI Cal-Lab By: mmw
 CAL: 03/14/99 DUE: 03/14/00
 AN: 004828 SN: 91E34523

PARTS

Part Name	Part Number	Cost	Failure Description

WORK SUMMARY

Failure Description _____
 Repair Action _____
 Cal Procedure CL-9 May 99 Temp 74 F Hum 51 %
 Tech [Signature] Cal Hrs. 2h Repair Hrs. _____ Part Cost _____
 Action Taken Cal
 Standards Used 219 5174
 Date Cal 3-2-00 Int. 6 Mo. Date Due 9-2-00 Reliability Code _____
 Date Picked Up 3/22/2000 Picked Up By [Signature]

37935

CALIBRATION CHECK FORM

Date Calibrated 3-2-00 Work Order 37935 Cal By *[Signature]*

Procedure No./Date CL-9-Mar99 Unit Under Test Chart recorder

Mfg. Blue M Model BM71 SN 91E34523 AN 4828

STEP	FUNCTION OR RANGE	APPLIED	TOLERANCE		MEASURED VALUES		P/F
			MIN	MAX	AS FOUND	RELEASED	
TOP		0°C	-1	+1	0°C		P
		27.76°C	26.76	28.76	28°C		P
		41.44°C	40.44	42.44	41°C		P
		79.83°C	78.83	80.83	80°C		P
Bottom		0°C	-1	+1	0°C		P
		27.76°C	26.76	28.76	27°C		P
		41.44°C	40.44	42.44	41°C		P
		79.83°C	78.83	80.83	79°C		P



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



Certificate #
0972-01

Certificate of Calibration

2 March 2000

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: BLUE M ELECTRIC CO. BM711100000011
Description: CHART RECORDER
Serial Number: 91E34523
Asset Number: 004828

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NC SL Z540-1-1994. The results of this calibration relate only to the individual item as described above. 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 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.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

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: 74.0 Degrees Fahrenheit Humidity: 51 % RH

Calibration Date: 2 Mar 00 **Calibration Procedure:** CL-9 MAY99

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

Remarks:

Approved by:

Jim Patterson, Supervisor, or Walt Hill, Metrologist
Certificate # 37935

m:\a2la.rpt Rev date 14 Dec 99

Measurements performed by:

Mack Wood, Technician

Page 1 of 1

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by RCRUZ at 8:44:40AM on 10/24/00

I4213

1 10000 0000 0000 0000 0000 0000 0000

Work Order No 444041085

Arrived 10/24/00

Asset No. 004828 Manufacturer BLUE M ELECTRIC CO.

Model BM711100000011

Instrument Type/Class CHART RECORDER

Serial No. 91E34523

Accessory No. Calibration Procedure CL-9, 5/99

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel. 6090

Charge/Project No. 20.00751.006

Delivered By / Telephone DARRELL DUNN

IN4CAL

Special Instructions | _____

WORK NOTES

Date	Hours	Remarks/Notes
<u>25 OCT 00</u>		<u>Calibrate</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

REPAIR PARTS

Date	Hours	Part Name	Part Number	Failure Description	Cost
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

WORK SUMMARY

Failure Description _____

Repair Action _____

Calibration Procedure CL-9 5199 Temp 75 F Hum. 50 %

Tech A. P. ... Totals Cal Hours 1 Repair Hours _____ Parts Cost _____

Standards Used 219

Date Picked Up 11/6/2000 Picked Up By [Signature]

41085



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



Certificate #
0972-01

Certificate of Calibration

25 October 2000

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: BLUE M ELECTRIC CO. BM711100000011
Description: CHART RECORDER
Serial Number: 91E34523
Asset Number: 004828

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. The results of this calibration relate only to the individual item as described above. 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 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.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

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: 75.0 Degrees Fahrenheit Humidity: 50 % RH

Calibration Date: 25 Oct 00 **Calibration Procedure:** CL-9, 5/99

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

Remarks:

Approved by:

Jim Patterson, Supervisor, or Walt Hill, Metrologist

Certificate # 444041085

m\A2LA.rpt Rev date 22 May 00

Measurements performed by:

Tony Planas, Technician



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



Certificate #
0972-01

Certificate of Calibration

15 May 2001

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: BLUE M ELECTRIC CO. BM71110000011
Description: CHART RECORDER
Serial Number: 91E34523
Asset Number: 004828
Work Order Number: 444043514

This certifies the above item was calibrated in compliance with MIL-STD-45662A and ANSI/NCSL Z540-1-1994. The results of this calibration relate only to the individual item as described above. 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 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.

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results of this calibration certificate were determined in accordance with the terms of accreditation unless stated otherwise below.

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: 76.0 Degrees Fahrenheit Humidity: 44 % RH

Calibration Date: 15 May 01 **Calibration Procedure:** CL-9, 5/99

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

Remarks:

Approved by:

Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:

Ken Harp, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by JIBARRA, 1/8/02 11:36:03AM

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

Arrived 1/8/02

Work Order **444046662**

Asset No. 004828 Manufacturer BLUE M ELECTRIC CO.

Model BM711100000011

Equipment Type CHART RECORDER

Serial No. 91E34523

Accessory No.

Interval 6 M

Calibration Procedure CL-9, 5/99

Location B57

Div/Client DIV20

Custodian DARRELL DUNN

Mail Stop B57

Tel 6090

IN4CAL

Special Instructions 20.00751.006

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

Charge/Project No. 00751.006 1.20

Requester / Telephone DARRELL DUNN/ X6090

This information is correct for the work requested. *Darrell Dunn*

WORK NOTES

Date	Hours	Remarks/Notes
<u>1/15/02</u>	<u>2.0</u>	<u>Cal</u>
<u>1/16/02</u>	<u>1.5</u>	<u>Cal</u>
<u>1/21/02</u>	<u>2.0</u>	<u>Cal</u>

Date	Hours	Part Name	Part Number	Failure Description	Cost
<u>n/A</u>	<u>2</u>				

WORK SUMMARY

Failure Description Pen # 1 OOT
Repair Action Recalibrated
Tech R Dykster Cal Hrs. 4.5 Repair Hrs. Parts Cost Temp 76 F Hum. 42 %
Standards Used 000215

Date Picked Up 1/29/02

Picked Up By *Darrell Dunn*

444046662

Chart Uncertainty

Measurement uncertainty Budget for Blue M Electric recorder Model BM7000.

UUT Characteristics

Temperature
Chart

Performance Specifications

Range: -20 to 100 Degree C
Resolution: 1.0 Degree C (Chart)
Tolerance: 1% of chart span (1.3 degree C)
Plus .01% of span per degree C from 25 degree C

Temperature
Display

Range: -20 to 100 Degree C
Resolution: 1.0 Degree C (Display)
Tolerance: 0.25% of reading + 1.0 degree C
Plus .01% of span per degree C from 25 degree C

The following are assumptions and estimates used in the measurement uncertainty budget.

- a) Resolution of chart 1.0
- b) Repeatability is not significant.

			1.30	0.325
	Units	Reading	Accuracy +/-	Resolution
	Degree C	0	1.63	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	54.2	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.4	to 1		

Chart Uncertainty

Display			1.30	0.195
	Units	Reading	Accuracy +/-	Resolution
	Degree C	10	1.50	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	49.8	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.3	to 1		

Display			1.30	0.065
	Units	Reading	Accuracy +/-	Resolution
	Degree C	20	1.37	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	45.5	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.2	to 1		

Chart Uncertainty

Display	1.30		0.065	
	Units	Reading	Accuracy +/-	Resolution
	Degree C	30	1.37	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	45.5	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.2	to 1		

Display	1.30		0.195	
	Units	Reading	Accuracy +/-	Resolution
	Degree C	40	1.50	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	49.8	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.3	to 1		

Chart Uncertainty

Display	1.30		0.325	
	Units	Reading	Accuracy +/-	Resolution
	Degree C	50	1.63	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
	TI Acc. /STD Acc.			
Test Accuracy Ratio (TAR)	54.2	to 1		
	TI ACC / Muk=2			
Test Uncertainty Ratio (TUR)	1.4	to 1		

Display Uncertainty

Measurement uncertainty Budget for Blue M Electric recorder Model BM7000.

UUT Characteristics

Temperature
Chart

Performance Specifications

Range: -20 to 100 Degree C
Resolution: 1.0 Degree C (Chart)
Tolerance: 1% of chart span (1.3 degree C)
Plus .01% of span per degree C from 25 degree C

Temperature
Display

Range: -20 to 100 Degree C
Resolution: 1.0 Degree C (Display)
Tolerance: 0.25% of reading + 1.0 degree C
Plus .01% of span per degree C from 25 degree C

The following are assumptions and estimates used in the measurement uncertainty budget.

- a) Resolution of chart 1.0
- b) Repeatability is not significant.

	Units	Reading	1.00	0.325
	Degree C	0	Accuracy +/-	Resolution
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	44.2	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.1	to 1		

Display Uncertainty

Display		1.00		0.195	
	Units	Reading	Accuracy +/-	Resolution	
	Degree C	10	1.20	1	
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C	
Standard	0.03	Rectangular	Sqrt 3	0.017	
Repeatability	0	Rectangular	Sqrt 3	0.000	
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577	
Combined Uncertainty	RSS			0.58	
Expanded Uncertainty	K=2			1.16	
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.				
	39.9	to 1			
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2				
	1.0	to 1			

Display		1.01		0.065	
	Units	Reading	Accuracy +/-	Resolution	
	Degree C	20	1.07	1	
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C	
Standard	0.03	Rectangular	Sqrt 3	0.017	
Repeatability	0	Rectangular	Sqrt 3	0.000	
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577	
Combined Uncertainty	RSS			0.58	
Expanded Uncertainty	K=2			1.16	
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.				
	35.7	to 1			
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2				
	0.9	to 1			

Display Uncertainty

Display			1.01	0.065
	Units	Reading	Accuracy +/-	Resolution
	Degree C	30	1.07	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	35.8	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	0.9	to 1		

Display			1.01	0.195
	Units	Reading	Accuracy +/-	Resolution
	Degree C	40	1.21	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	40.2	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.0	to 1		

Display Uncertainty

Display	1.01	0.325		
	Units	Reading	Accuracy +/-	Resolution
	Degree C	50	1.34	1
Source of uncertainty	Value +/- Deg C	Distribution	Divisor	Standard Uncertainty C
Standard	0.03	Rectangular	Sqrt 3	0.017
Repeatability	0	Rectangular	Sqrt 3	0.000
Instrument Resolution (UUT)	1	Rectangular	Sqrt 3	0.577
Combined Uncertainty	RSS			0.58
Expanded Uncertainty	K=2			1.16
Test Accuracy Ratio (TAR)	TI Acc. /STD Acc.			
	44.6	to 1		
Test Uncertainty Ratio (TUR)	TI ACC / Muk=2			
	1.2	to 1		



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

Certificate of Calibration

22 January 2002

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: BLUE M ELECTRIC CO. BM71110000011
Description: CHART RECORDER
Serial Number: 91E34523
Asset Number: 004828
Work Order Number: 444046662

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: 76.0 Degrees Fahrenheit Humidity: 40 % RH

Calibration Date: 22 Jan 02 **Calibration Procedure:** CL-9, 5/99

Condition as Received: OUT OF TOLERANCE

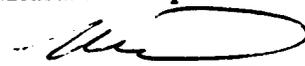
Condition as Returned: IN TOLERANCE

Remarks:

Approved by:


Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:


Roger Dykstra, Technician