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

WORK ORDER

CERTIFICATE # 34365 ASSET # 001303 DATE 04 May 99

ITEM DATA:

Manufacturer Fritsch Model No Mfr Name

Description Thermometer Serial # F98.273

Accessories Probe

ACTION REQUESTED Cal

CUSTODIAN Div. 20, Darrell Dunn

Turned in by: _____ Phone 6490

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 MAL Date 05-04-99

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

CAL ENVIRONMENT:
Temperature 75 °F Humidity 57 %RH

CALIBRATED/REPAIRED:
By [signature] Cal Procedure TD3245-4-4C-1 Av.97
Date 5-5-99 Accuracy ± 1°C
Cal Interval 6 mo Reliability Code: _____
Next Cal due 11-5-99 Cal Time 1h Repair Time _____
Standards used (Asset#) 5174, 7001

DATE COMPLETED 5-6-99
DATE PICKED UP 5/13/99 PICKED UP BY [signature]

SwRI Form QA-174-0

34365

CALIBRATION CHECK FORM

Date Calibrated 5-5-99 Work Order 34365
Technician CM Wood Calibration Procedure 7033KS-4-42-1 Ap.97
Unit Under Test Thermometer
Manufacturer Fisher Model 15-166A SN E98-273 ASN 7303

STEP	FUNCTION OR RANGE	APPLIED °C	TOLERANCE MIN - MAX ±1°R	MEASURED VALUES AS FOUND	MEASURED VALUES RELEASED	P/F
1)		-16.37	-15.37 - -17.37	-17.0		P
2)		13.57	12.57 - 14.57	14.0		P
3)		46.26	45.26 - 47.26	47.1		P
4)		81.86	80.86 - 82.86	82.0		P
5)		115.89	114.89 - 116.89	116.1		P
6)		144.84	143.84 - 145.84	145.5		P

SOUTHWEST RESEARCH INSTITUTE
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Calibration Laboratory • 522-5215

WORK ORDER

WORK ORDER # 36959 ASSET # 00 7915 DATE 11 Nov 99

ITEM DATA:

Manufacturer Fisher Model Astm 1C

Description Thermometer Serial # E99-213

Accessories _____

ACTION REQUESTED Cal

_____

CUSTODIAN Dr. D. Daniel Lucas

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 [illegible] Date 11/19/99

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) Calibrated & Returned

_____

_____

_____

_____

CAL ENVIRONMENT:

Temperature 75 °F Humidity 52 %RH

CALIBRATED/REPAIRED:

By [signature] Cal Procedure CC-9, Rev 8

Date 22 Nov 99 Accuracy +/- 1 deg

Cal Interval 6 Mos Reliability Code 2

Next Cal Due 22 May 00 Cal Time 2 Repair Time _____

Standards used (Asset #) 5213, 5174

_____

DATE COMPLETED 22 Nov 99

DATE PICKED UP 11/23/99 PICKED UP BY [signature]

SwRI Form QA-174-0

36959

CALIBRATION WORKSHEET

Date Calibrated 22Jun99 Work Order 36838 Cal By 8216

Procedure No./Date CL-9, May 99 Unit Under Test Thermometer

Mfg. [illegible] Model 15 NGA SN 598-273 AN 7303

STEP	FUNCTION OR RANGE	APPLIED	TOLERANCE MIN - MAX	MEASURED VALUES AS FOUND	MEASURED VALUES RELEASED	P/F
		°C	+/- 1°C	°C		
	20% Range	14.00		14		P
	40% Range	48.00		48		P
	60% Range	82.00		82		P
	80% Range	116.00		116		P
	100% (-1 Div)	149.0		149		P

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Department of Quality Assurance
Calibration Laboratory

Accredited

Certificate #
0972-01

Certificate of Calibration

22 November 1999

Issued to:	DARRELL DUNN DIV20 B57
Manufacturer/Model:	ERTCO 76MM 1MM
Description:	THERMOMETER
Serial Number:	E98-273
Asset Number:	007303

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.

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: 52 % RH

Calibration Date: 22 Nov 99 **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

Measurements performed by:

Ken Harp, Technician

Certificate # 36838

m:\a2la.rpt Rev date 10 Mar 99

WORK ORDER 39215

Date Received 5/25/00

Asset No. 007303 **Manufacturer** ERTCO **Model** 76MM 1MM
Description THERMOMETER **Serial Number** E96-273
Accessory Received/Required NONE
Div/CC ID NONE **Accessory to Asset No.** N/A
Div/CC DIV20 **Location** B57 **Custodian** DARRELL DUNN **Tel.** 6090
Charge/Project No. 20.00751.006 **Proprietary/Confidental** N **Date Required** ROUTINE
Work Requested CALIBRATION
Receiving Inspection O.K.
Delivered By DARRELL DUNN **Tel.** 6090

WORK HISTORY

Date	Start Time	Stop Time	Notes

PARTS

Part Name	Part Number	Cost	Failure Description

39215

WORK SUMMARY

Failure Description _____

Repair Action _____

Cal Procedure CL-9, 5/99 **Temp** 26 F **Hum** 47 %

Tech JW **Cal Hrs.** .7 **Repair Hrs.** _____ **Part Cost** _____

Action Taken cal

Standards Used 215 5174

Date Cal 1 Dec 2000 **Int.** 6 **Mo. Date Due** 1 Dec 2000 **Reliability Code** 3

Date Picked Up 6/2/00 **Picked Up By** _____

worktreq.rpt Rev 30 Jan 00

CALIBRATION CHECK FORM

Date Calibrated 1 JUN 200 Work Order 39215 Cal By JD

Procedure No./Date : CL-9, May99 Unit Under Test Thermometer,

Mfg. ENTCO Model 76MM 1MM SN E98-273 AN 7303

STEP	FUNCTION OR RANGE	APPLIED	TOLERANCE	MEASURED VALUES		P/F
			MIN - MAX	AS FOUND	RELEASED	
4.1	Temperatre Calibration					
	Lowest value of Range + 2 Div.	15.99		-20.6		
	20% Range	15.01		15.0		
	40% Range	49.70		50.0		
	60% Range	85.05		85.0		
	80% Range	120.04		120.0		
	Highest value of Range -2 Div.	149.94		149.5		
		25		25.5		

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Certificate #
0972-01

Certificate of Calibration

1 June 2000

Issued to:	DARRELL DUNN DIV20 B57
Manufacturer/Model:	ERTCO 76MM 1MM
Description:	THERMOMETER
Serial Number:	E98-273
Asset Number:	007303

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.

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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: 47 % RH

Calibration Date: 1 Jun 00 **Calibration Procedure:** CL-9, 5/99

Condition as Received: In Tolerance

Remarks:

Approved by:

Jim Patterson, Supervisor, or Walt Hill, Metrologist

Measurements performed by:

Jerry White, Technician

Certificate # 39215

m:\a2la.rpt Rev date 22 May 00

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by JIBARRA at 8:35:03AM on 1/12/01

Work Order 444042028 Arrived 1/12/01

Asset No. 007303 Manufacturer ERTCO Model 76MM 1MM

Instrument Type/Class THERMOMETER Serial No. E98-273

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/ X6090

IN4CAL Special Instructions _____

WORK NOTES

Date	Hours	Remarks/Notes

REPAIR PARTS

Date	Hours	Part Name	Part Number	Failure Description	Cost

444028

WORK SUMMARY

Failure Description _____

Repair Action _____

Calibration Procedure CL-9, 5/99 Temp 74 F Hum. 30 %

Tech VMorales Totals Cal Hours 1.0 Repair Hours _____ Parts Cost _____

Standards Used 219

Date Picked Up 1/31/2001 Picked Up By _____

Southwest Research Institute
Calibration Laboratory

Work Order 4440[illegible]2008	Mfg. Ertco	Tech UMack
Asset No. 7303	Model 76MM 1MM	Procedure CC-9, 5/99
Serial No. E98-273	Type Thermometer	Cal Date 29 JAN 01

Calibration As Found/As Released Data

Parameter	Standard Reading	UUT As Found	Tolerance	UUT As Released
Temperature	Actual			
-20Deg.C.	-20.00 °C	-20.2 °C	+/-0.5DegC	
0.0Deg.C.	.01 °C	0.0 °C	+/-0.5DegC	
50Deg.C.	50.05	50.1 °C	+/-0.5DegC	
100Deg.C.	100.07	100.0 °C	+/-0.5DegC	
150Deg.C.	149.93 °C	149.9 °C	+/-0.5DegC	

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Department of Quality Assurance
Calibration Laboratory

Certificate #
0072-01

Certificate of Calibration

29 January 2001

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: ERTCO 76MM 1MM
Description: THERMOMETER
Serial Number: E98-273
Asset Number: 007303
Work Order Number: 444042028

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: 74.0 Degrees Fahrenheit Humidity: 36 % RH

Calibration Date: 29 Jan 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:

Vince Morales, Technician

m:\a2la.rpt Rev date 8 Jan 01

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by RCRUZ,8/22/01 8:35:28AM

Arrived 8/22/01 Work Order **444044944**

Asset No. 007303 Manufacturer ERTCO Model 76MM 1MM

Instrument Type/Class THERMOMETER Serial No. E98-273

Accessory No. Calibration Procedure CL-9, 5/99 Location B57

Div/Client DIV20 Custodian DARRELL DUNN Mail Stop B57 Tel. 6090

IN4CAL Special Instructions _____

Notify before making adjustments or repairs. ✓ Provide measurment readings ✓

Charge/Project No. 00751.006 1.20 Requested By / Telephone

The above is correct for the work requested. _____

WORK NOTES

Date	Hours	Remarks/Notes
8/23	1.0	Calibration

Date	Hours	Part Name	Part Number	Failure Description	Cost

WORK SUMMARY

Failure Description N/A

Repair Action N/A

Calibration Procedure CL-9, 5/99 Temp 74 F Hum. 57 %

Tech R Dykstra Totals Cal Hours 1.0 Repair Hours _____ Parts Cost _____

Standards Used 0219, 0328

Date Picked Up 9/4/01 Picked Up By _____

Southwest Research Institute
Calibration Laboratory
Calibration Data Sheet

Work Order 444044944	**Mfr.** ERTCO	**Technician** R Dykstra
Asset No. 007303	**Model** 76MM 1MM	**Procedure** CL-9, 5/99
Serial No. E98-273	**Type** Thermometer	**Cal Date** 8/23/01

Remarks: The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k*=2, which provides a level of confidence of approximately 95%. The test limits are not specified.

Parameter	Standard Reading	Found/Left	Error	Test Limits	Uncertainty
Temperature	-19.59 °C	-20.0 °C	-0.41 °C		0.06 °C
	-0.12 °C	0.00 °C	-0.12 °C		0.06 °C
	49.91 °C	50.0 °C	-0.09 °C		0.06 °C
	99.97 °C	99.8 °C	0.17 °C		0.06 °C
	150.05 °C	149.8 °C	0.25 °C		0.06 °C

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Department of Quality Assurance
Calibration Laboratory

Certificate #
0972-01

Certificate of Calibration

23 August 2001

Issued to:	DARRELL DUNN DIV20 B57
Manufacturer/Model:	ERTCO 76MM 1MM
Description:	THERMOMETER
Serial Number:	E98-273
Asset Number:	007303
Work Order Number:	444044944

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: 74.0 Degrees Fahrenheit Humidity: 57 % RH

Calibration Date: 23 Aug 01 **Calibration Procedure:** CL-9, 5/99

Condition as Received: SEE ATTACHED DATA

Condition as Released: SEE ATTACHED DATA

Remarks:

Approved by:

Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:

Roger Dykstra, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Received by RCRUZ,2/12/02 11:21:21AM

Arrived 2/12/02 Work Order **444047215**

Asset No. 007303 Manufacturer ERTCO Model 76MM 1MM

Equipment Type THERMOMETER Serial No. E98-273 Accessory No.

Interval 6 M Calibration Procedure CL-9, 5/99 Location B57

Div/Client DIV20 Custodian DARRELL DUNN Mail Stop B57 Tel 6090

QUEUE Special Instructions

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
2/21/02	1	Cal
2/22/02	.5	Cal

Date	Hours	Part Name	Part Number	Failure Description	Cost

WORK SUMMARY

Failure Description

Repair Action

Tech BDykstra Cal Hrs. 1.5 Repair Hrs Parts Cost Temp F Hum. %

Standards Used

Date Picked Up 3/6/02 Picked Up By

47215

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Department of Quality Assurance
Calibration Laboratory

Certificate of Calibration

February 2002

Issued to:	DARRELL DUNN D 357
Manufacturer/Model:	ERTCO 76MM IMS
Description:	THERMOMETER
Serial Number:	E98-273
Asset Number:	007303
Work Order Number:	4440-7215

This certifies the above item was calibrated in accordance 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 this calibration 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: 75.0 Degrees Fahrenheit Humidity: 25 % RH

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

Condition as Received: IN TOLERANCE

Condition as Returned: IN TOLERANCE

Remarks: COMPLIANCE TESTED THERMOMETER TO A SPECIFICATION OF +/- 1 DEGREE C, RANGE -20 TO 150 DEGREE C.

Approved by:

Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:

Roger Dykstra, Technician

Southwest Research Institute
Calibration Laboratory
Calibration Data Sheet

Workorder 444047215	**Mfr.** Ertco	**Technician** R Dykstra
Asset #. 007303	**Model** 76MM 1MM	**Procedure** CL-9, 5/99
Serial #. E98-273	**Type** Thermometer	**Cal Date** 2/22/02

Ambient Conditions:

Temperature	7[illegible]	**Degree F**
Humidity	2[illegible]	**% R.H.**
Baro. Pressure	N/A	**PSIA**

Data sheet Revision:
Revision 0 2/21/02

Standards used:

Asset #	Due Date	Nomenclature
005243	12/0[illegible]02	H.P. 34420A Digital Multi-Meter
005174	02/18/03	RTD probe

[illegible] state[illegible]nt of [illegible]mpli[illegible]ce to a specification requested. **Yes**
(If stater[illegible]ent is required. print yes otherwise leave blank)

Tole[illegible]ce 1.00 **Degree C** **Range** -20 to 150 **Degree C**
(If not required leave blank)

Degree C Deg[illegible] C Degree C Degree C Degree C

	As Found				
Std Reading	**TI Reading**	**Error**	**Test Limits**	**Uncertainty**	**Results**
-20.00	-2[illegible]	-0.20	1	0.35	Pass
0.09	-0.[illegible]	-0.29	1	0.35	Pass
50.00	50.0	-0.00	1	0.35	Pass
99.94	99.8	-0.14	1	0.35	Pass
149.91	149.6	-0.31	1	0.35	Pass

Remarks:

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2. which provides a level of confidence of approximately 95%.
If compliance testing to a specification is requested. The results can be pass, fail, or if blank "Not determinable". If results are not determinable it is to end user to determine if results meet thier needs.
If compliance testing to a specification is not requested, only data and uncertainty will be given on data sheet.
The tolerance is given in procedure and on previous data sheets.

Measurement uncertainty Budget for Degree C thermometers.

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

a.) Able to read the thermometer to a resolution of 1/5 smallest inc. with the aid of a magnifier.

b.) Repeatability is not significant.

c.) Bath stability & gradients for the Various Baths

Model 7030 (-30 to 150 C)	**0.01**	**Degree C**
Model 6055 (200 to 550 C)	**0.01**	**Degree C**
Model 6035 (30 to 300 C)	**0.01**	**Degree C**

d.) The best Uncertainty for Hart 5699 SPRT w/ HP 34420

-200 to 420 C	**0.0033**	**Degree C**
420 to 660 C	**0.004**	**Degree C**

e.) Used the worst case from d above in budget.

	Units	Range	Accuracy +/-	Resolution
	Degree C	-20 to 150	1	0.2
Source of uncertainty	**Value +/- Deg C**	**Distribution**	**Divisor**	**Standard Uncertainty Deg C**
Standard	**0.004**	**Normal**	**1**	**0.00**
Bath Stability	**0.01**	**Rectangular**	**Sqrt 3**	**0.01**
Repeatability	**0**	**Normal**	**1**	**0.00**
Instrument Resolution	**0.2**	**Rectangular**	**2*Sqrt 3**	**0.17**
Combined Uncertainty			**RSS**	**0.17**
Expanded Uncertainty			**K=2**	**0.3**