

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

WORK ORDER

CERTIFICATE # 25039 ASSET # 005134 DATE 07 Apr 97

ITEM DATA:

Manufacturer Fisherbrand / tdao Model 5 16611
 Description 10000000 Serial # C46-183
 Accessories _____

ACTION REQUESTED 10' 10000000 info system

CUSTODIAN DIV. 10, Dan Juma

Turned in by: _____ Phone 660

CHARGE # 20-5700-501 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) Calibrated for Recurrence.

UKB
 _____ -0.01°C 0.0°C
 _____ -9.97°C 10.0°C
 _____ 45.02°C 45.0°C

CAL ENVIRONMENT: _____
 Temperature 77°F Humidity 27%RH

CALIBRATED/REPAIRED:
 By Handcamp Cal Procedure 41-9-30-5163
 Date 15 Apr 97 Accuracy ±1°C
 Cal Interval 6 mths Time to complete: _____
 Next Cal due 15 Oct 97 Cal 2.5 Repair _____
 Standards used (Asset#) 106, 5174

DATE COMPLETED 17 Apr 97
 DATE PICKED UP 4/17/97 PICKED UP BY [Signature]

25039

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

WORK ORDER

CERTIFICATE # 27264 ASSET # 005434 DATE 10 OCT 97

ITEM DATA:

Manufacturer Fisher/Traco Model 15-16A
Description Chem Analyser Serial # 196-783
Accessories _____

ACTION REQUESTED cal

CUSTODIAN Dr. J. D. Smith

Turned in by: _____ Phone 600

CHARGE # 20 1402-561 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 by Procedure

CAL ENVIRONMENT:
Temperature 78 °F Humidity 41 %RH

CALIBRATED/REPAIRED:
By [Signature] Cal Procedure ASTM E77-92
Date 29 OCT 97 Accuracy ±1°C
Cal Interval 6 mths Reliability Code: 2
Next Cal due 29 Apr 98 Cal Time 1.5 Repair Time _____
Standards used (Asset#) 219, 328

DATE COMPLETED 30 OCT 97
DATE PICKED UP 11/2/97 PICKED UP BY [Signature]

27264

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

WORK ORDER

CERTIFICATE # 29652 ASSET # 0051321 DATE 08 May 98

ITEM DATA:
Manufacturer Fisherbrand Series Model 15166A
Description Thermometer Serial # 176-783
Accessories _____

ACTION REQUESTED 101

CUSTODIAN Duro, Janet Dami

Turned in by: _____ Phone 6070

CHARGE # 10110-511 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 me/xl Date 050898

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

29652

ACTION TAKEN: (Calibration/Repair/Parts) Calibrated Per Procedure
#1 445
-0.05°C 0.0°C

CAL ENVIRONMENT:
Temperature 80 °F Humidity 32 %RH

CALIBRATED/REPAIRED:
By [Signature] Cal Procedure ASTM E77-89
Date 11 May 98 Accuracy 1/29 Spec
Cal Interval 6 mos Reliability Code: 3
Next Cal due 11 Nov 98 Cal Time 1.5 Repair Time _____
Standards used (Asset#) 219, 328

DATE COMPLETED 11 May 98
DATE PICKED UP 5/15/98 PICKED UP BY [Signature]

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

WORK ORDER

CERTIFICATE # 32912 ASSET # 005434 DATE 12 Jan 99

ITEM DATA:

Manufacturer Fisher Brand Model 15-106A
 Description Thermometer Serial # 146-783
 Accessories _____

ACTION REQUESTED 18

CUSTODIAN Daniel Duna, Jr. 20

Turned in by: _____ Phone 6040

CHARGE # 20-1407-571 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 MAK Date 01-12-99

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) 0 - 100
49.95 - 50.0 +1-100K P P
99.98 101.0 P

32912

CAL ENVIRONMENT:
 Temperature 73 °F Humidity 48 %RH

CALIBRATED/REPAIRED:
 By [Signature] Cal Procedure ASTM E77-89
 Date 15 Jan 99 Accuracy +1-10C
 Cal Interval 6 Reliability Code: _____
 Next Cal due 15 JUL 99 Cal Time 1 Repair Time _____
 Standards used (Asset#) 217 8174

DATE COMPLETED 15 Jan 99
 DATE PICKED UP 2/2/99 PICKED UP BY [Signature]

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

WORK ORDER

WORK ORDER # 35664 ASSET # 005434 DATE 16 Aug 99

ITEM DATA:

Manufacturer Fisher Scientific Model 15-166A
 Description Thermometer Serial # C96-783
 Accessories clear tube case

ACTION REQUESTED cal

CUSTODIAN Div. 20, Darrell Dunn

Turned in by: _____ Phone 6090

CHARGE # 20-OH 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 J. J. de Date 16 Aug 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)

	Standard	Reading
	-18.88	-19.0
	ICE	0.0
	36.77	31.0
	74.65	74.2
	102.03	102.0
	149.19	149.0

CAL ENVIRONMENT:
 Temperature 76 °F Humidity 44 %RH

CALIBRATED/REPAIRED:
 By [Signature] Cal Procedure CL-9 MAY 99
 Date 18 AUG 99 Accuracy ±.5°
 Cal Interval 6 Reliability Code 5
 Next Cal Due 18 FEB 00 Cal Time 2 Repair Time _____
 Standards used (Asset #) 219 328

DATE COMPLETED 18 AUG 99
 DATE PICKED UP 8/30/99 PICKED UP BY [Signature]

35664

WORK ORDER 37932

Date Received 2/24/00

Asset No. 005434 Manufacturer FISHER SCIENTIFIC Model 15-166A
 Description THERMOMETER Serial Number C96-783
 Accessory Received/Required TUBE
 Div/CC ID NONE Accessory to Asset No. N/A Accuracy +/-1 DEG.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. 6090

WORK HISTORY

Date	Start Time	Stop Time	Notes

Suffi Cal-Lab By:
 CAL: 02/16/99 DUE: 02/16/00
 AN: 005434 SN: C96-783

PARTS

Part Name	Part Number	Cost	Failure Description

WORK SUMMARY

Failure Description _____

Repair Action _____

Cal Procedure CL-9 May 99 Temp 76 F Hum 49 %

Tech Cal Hrs. 1 Repair Hrs. _____ Part Cost _____

Action Taken

Standards Used 219, 51M

Date Cal 3-2-00 Int. 6 Mo. Date Due 9-2-00 Reliability Code _____

Date Picked Up 3/27/2000 Picked Up By

37932



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: FISHER SCIENTIFIC 15-166A
Description: THERMOMETER
Serial Number: C96-783
Asset Number: 005434

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: 49 % 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 # 37932

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 0000 0000 0000 0000 0000 0000 0000

Work Order No 444041087

Arrived 10/24/00

Asset No. 005434 Manufacturer FISHER SCIENTIFIC

Model 15-166A

Instrument Type/Class THERMOMETER

Serial No. C96-783

Accessory No. Calibration Procedure CL-9 MAY99

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
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

REPAIR PARTS

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

WORK SUMMARY

Failure Description _____

Repair Action _____

Calibration Procedure CL-9, MAY99

Temp 75F

Hum. 50 %

Tech VMorales

Totals

Cal Hours 1.5

Repair Hours _____

Parts Cost _____

Standards Used 219

Date Picked Up 11/6/2000

Picked Up By Darrell Dunn

41087



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

3 November 2000

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: FISHER SCIENTIFIC 15-166A
Description: THERMOMETER
Serial Number: C96-783
Asset Number: 005434

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: 75.0 Degrees Fahrenheit Humidity: 50 % RH

Calibration Date: 27 Oct 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 # 444041087

m:\a2la.rpt Rev date 22 May 00

Measurements performed by:

Vince Morales, Technician

SOUTHWEST RESEARCH INSTITUTE

Calibration Laboratory

WORK ORDER

Processed by RCRUZ at 2:38:38PM on 4/26/01

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

Work Order 444043356

Arrived 4/26/01

Asset No. 005434 Manufacturer FISHER SCIENTIFIC Model 15-166A

Instrument Type/Class THERMOMETER Serial No. C96-783

Accessory No. Calibration Procedure CL-9 MAY99 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 20.00751.006

WORK NOTES

Date	Hours	Remarks/Notes
<u>5-1-01</u>	<u>1.0</u>	<u>Calibration</u>

REPAIR PARTS

Date	Hours	Part Name	Part Number	Failure Description	Cost

WORK SUMMARY

Failure Description None
Repair Action None
Calibration Procedure CL-9, 5/99 Temp 72 F Hum. 42 %
Tech R Dykes Totals Cal Hours _____ Repair Hours _____ Parts Cost _____
Standards Used S174, S243

Date Picked Up 5/2/01 Picked Up By [Signature]

43356

To: rdykstra@qacal@swri30
From: "Darrell Dunn" <ddunn@swri.edu>
Cc:
Subject: RE: Thermometers
Attachment: Headers.822
Date: 5/1/01 11:59 AM

+/- 1 degree is sufficient for our needs. I see no reason to change what we have done in the past.

-----Original Message-----

From: rdykstra@swri.edu (mailto:rdykstra@swri.edu)
Sent: Tuesday, May 01, 2001 10:51 AM
To: ddunn@swri.edu
Cc: WHill@swri.edu
Subject: Thermometers

Darrel, you have 11 Partial-Immersion thermometers in for calibration.

In the past they have been calibrated with an accuracy of +/- 1 Deg C. (Range is -20 to 150 Deg C). Is this accuracy sufficient for your needs?

The reason I am asking is the thermometers are labelled as ASTM 1C thermometers and according to the ASTM the scale error accuracy is +/- 0.5 Deg C.

I do not have all the data collected as of now. I will tell you so far all meet the +/- 1 deg C, not all are meeting the +/- 0.5 deg C spec.

The asset numbers are as follows: 007164, 005434, 007167, 007165, 007169, 005432, 007166, 007168, 003242, 005433, and 007171.

Let me know what accuracy will fit your needs.

Roger Dykstra
Cal Lab. X5076



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 May 2001

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: FISHER SCIENTIFIC 15-166A
Description: THERMOMETER
Serial Number: C96-783
Asset Number: 005434
Work Order Number: 444043356

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: 72.0 Degrees Fahrenheit Humidity: 42 % RH

Calibration Date: 1 May 01 **Calibration Procedure:** CL-9 MAY99

Condition as Received: IN TOLERANCE

Condition as Released: IN TOLERANCE

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, 10/26/01 11:23:26AM

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

Arrived 10/26/01

Work Order **444045916**

Asset No 005434 Manufacturer FISHER SCIENTIFIC

Model 15-166A

Equipment Type THERMOMETER

Serial No. C96-783

Accessory No.

Interval 6 M

Calibration Procedure CL-9 MAY99

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 Type 2540)

Charge/Project No. 00751.006 1.20

Requester / Telephone

This information is correct for the work requested.



WORK NOTES

Date	Hours	Remarks/Notes
<u>10/30</u>	<u>1.5</u>	<u>Cal</u>

Date	Hours	Part Name	Part Number	Failure Description	Cost
<u>N/A</u>	<u>→</u>				

WORK SUMMARY

Failure Description n/a

Repair Action n/a

Tech RD/KSH Cal Hrs. 1.5 Repair Hrs Parts Cost Temp 76 F Hum. 44 %

Standards Used 517A, 5243

Date Picked Up 11/16/01

Picked Up By B. Dunn

444045916



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

Certificate of Calibration

30 October 2001

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: FISHER SCIENTIFIC 15-166A
Description: THERMOMETER
Serial Number: C96-783
Asset Number: 005434
Work Order Number: 444045916

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: 44 % RH

Calibration Date: 30 Oct 01 **Calibration Procedure:** CL-9 MAY99

Condition as Received: IN TOLERANCE

Condition as Received: IN TOLERANCE

Remarks:

Approved by:


Walt Hill, Supervisor
Institute Calibration Laboratory

Measurements performed by:


Roger Dykstra, Technician

Southwest Research Institute
 Calibration Laboratory
 Calibration Data Sheet Z 540

As found / left data

Workorder 444048238	Mfr. Fisher Scientific	Technician	R Dykstra
Asset #. 005434	Model 15-166A	Procedure	CL-9, 5/99
Serial #. C96-783	Type Thermometer	Cal Date	4/22/02

Remarks: The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor (k=2) providing a level of confidence of approximately 95%.

The Difference is equal to TI reading - Std reading.

The results can be Pass, Fail, or if blank "not determinable". If "not determinable" it is up to the end user to determine if results meet their needs.

Range	Test point	TI Reading	Difference	Tolerance	Uncertainty	Results
Degree C	Degree C	Degree C	Degree C	Degree C	Degree C	
0 to 150	-19.89	-20.4	-0.51	1	0.35	Pass
	0.10	0.0	-0.10	1	0.35	Pass
	50.00	49.8	-0.20	1	0.35	Pass
	99.94	99.2	-0.74	1	0.35	
	149.90	149.6	-0.30	1	0.35	Pass



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

Certificate of Calibration

22 April 2002

Issued to: DARRELL DUNN DIV20 B57
Manufacturer/Model: FISHER SCIENTIFIC 15-166A
Description: THERMOMETER
Serial Number: C96-783
Asset Number: 005434
Work Order Number: 444048238

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: 74.0 Degrees Fahrenheit Humidity: 55 % RH

Calibration Date: 22 Apr 02 **Calibration Procedure:** CL-9 MAY99

Condition as Received: SEE ATTACHED DATA

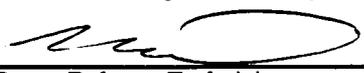
Condition as Returned: SEE ATTACHED DATA

Remarks:

Approved by:


Walt Hill, Metrology Group Leader
Institute Calibration Laboratory

Measurements performed by:


Roger Dykstra, Technician