

Tu, Scott

5-16
5102

To: Sharon Stohrer
Cc: Jereb, Thomas; Zemke, William; Jim Canaday; White, Charles; Kenzler, Eric
Subject: RE: QA/QC

Sharon:

The QA/QC package will be sent tomorrow by Overnight Express before 2 pm. It will be shipped to SWRCB office at 1001 I Street. If you want have it delivered at different address, please let me know before 10 am tomorrow, 7/9.

The package includes the following three types of equipment categories:

1. In-stream recording units (VEMCO). We will provide calibration certification datasheet for each VEMCO units that have been in service during 2003. We maintained all temperature loggers for the entire PG&E service territory and we rotated the units randomly, therefore, we are providing the entire suite of records we have. This is a heavy deck since there are 150+ units in service. The calibration included pre-season and post-season record. Summaries of both pre- and post-season calibration will be included.
2. Internal Powerhouses and others. Calibration record used to record water temperature internal powerhouses or pressure transducer units will be included.
3. Telemetered Stations. Calibration and repair (damaged by lightning) records of both telemetered stations (NF56 and NF57) are included. We also duplicated these two telemetered stations with in-situ loggers (in Category 1) as backup. Comparison between these two categories, which is another form of QA/QC, have been documented in the Annual Report (copy from the report is included for your reference).

In the package, you will have a hard copy and a CD which will include the electronic set of datasheets. Let me know if you need any additional information.

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

From: Sharon Stohrer [mailto:SSTOHRER@waterrights.swrcb.ca.gov]
Sent: Tuesday, July 06, 2004 7:49 PM
To: Tu, Scott
Cc: Jereb, Thomas; Zemke, William; Jim Canaday
Subject: QA/QC

Hi Scott,

I hope that you had a great holiday weekend! Now, back to business....

Please let me know the status of the NFFR water temperature QA/QC materials that you are compiling. As we discussed, I need to have the RC-C temperature program QA/QC information, along with Poe QA/QC and any additional UNFFR verification that you have. You said that you were certain that you could obtain all of the 2003 records on CD or in hard copy. This will be fine, and after review I can let you know if we need any additional records.

I would really appreciate having these records by the end of this week, if possible. If you have compiled this info would it be possible to overnight-mail them to me?

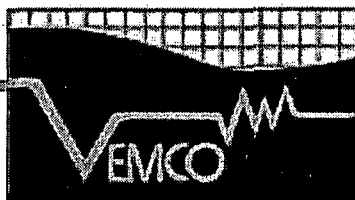
Thank you for your help on this matter. Sharon

~~~~~  
Sharon Stohrer  
State Water Resources Control Board  
1001 I Street, 14th Floor  
Sacramento, CA 95814  
(916) 341-5397

SSTOHRER@waterrights.swrcb.ca.gov  
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Temperature Loggers for Streams (Including NFFR)

- a) March-April 2003 Pre-season Calibration
- b) October 2003 Post-season Calibration



A Division of AMIRIX Systems Inc.

Minilog12, 12-bit Data Logger

Rugged, high-resolution temperature logger

Data Logger

The Minilog12 is a high-resolution data logger that records and stores temperature and time information. Minilog12's are waterproof, extremely rugged and ideal for a number of data collection applications. The device is used in combination with a Minilog PC interface unit for study initialization and data download. Some applications for the Minilog12 include:

- Monitoring temperatures in alpine lakes;
- Small stream management programs;
- Measuring temperature changes in lakes and ocean areas to determine the impact on local marine life;
- Soil temperature measurements and monitoring;
- Aquaculture site observation;
- Waste water temperature monitoring;
- Long line thermistor chains with multiple loggers;
- Food, drug and medical supply transportation monitoring.



The Minilog12 has no external electrical connections that could leak and users typically experience five years of battery life.

Minilog12 equipment is available in the following options:

Product Name	Description
12 - bit Minilog TX	Temperature sensor only; expendable
12 - bit Minilog TR	Temperature sensor only; Rugged plastic case
Optional memory	32 and 64 K [16K is standard]
PC interface & software	Connects to computer via DB9 connector

A single PC interface box can be used with a number of data loggers. However, for users with 20 or more data loggers, additional PC interface boxes can decrease the time required to download data by using several computers.

Contact us

August 2003

VEMCO, 100 Osprey Drive, Shad Bay, Nova Scotia Canada B3T 2C1
 Phone: +1-902-852-3047; Fax: +1-902-852-4000; Email: sales@vemco.com;
 Web: www.vemco.com

Specifications may change without notice.

Specifications:

Case	TX model: thin-walled epoxy cylinder TR rugged model: polycarbonate plastic
Weight	TX model: 23 g in air; 10 g in water TR rugged model: 41 g in air; 12 g in water
Size	TX model: 16 mm x 70 mm long: TR rugged model: 22 mm x 95 mm long
Maximum Depth	TX model: 340 m TR rugged model: 1000 m
Thermal Time Constant	45 seconds in stirred liquid.
Memory Capacity	Approximately 10,800 readings
Full Memory Download	6 minutes for 16 k standard memory version
Logging Duration	3 hours to 5 years
Logging Interval	User programmable from 1 second to 6 hours
Battery Life	5 years or 1200 full deployments
Data Retention	20 years
Memory Type	Non-volatile EEPROM
Power Supply	Single Lithium Cell, ½ AA size
Clock Drift	± 4 seconds per day [not tested]

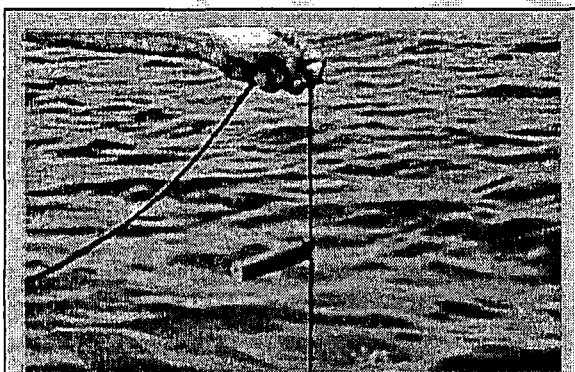
Software:

VEMCO's Minilog software is designed to be used in a Windows 95, 98 or NT environment and is included with the PC interface unit. Minilog software has a "delayed start" feature that allows the user to initialize a study and begin recording data at some time in the future. This option is useful for the synchronized start of a study with multiple loggers or when a study is to take place some distance away. Data is downloaded from the Minilog12 and stored as a binary file. The binary data file can then be displayed graphically or converted to an ASCII data file.

Temperature Range

Minilog12 is available in two standard temperature ranges but custom configurations are also available. The resolution & accuracy of the Minilog12 depend on the temperature range and are listed in the table below. [Resolution is defined as the fineness of detail that can be distinguished in a measurement. Accuracy is defined as the ability of a measurement to repeatedly match the actual value of the quantity being measured.]

Standard Range	Resolution	Accuracy
-5 to 40 °C	0.015 °C	± 0.1 °C
-30 to 40 °C	0.05 °C	± 0.2 °C



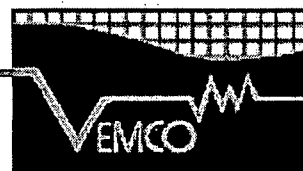
The Minilog 12 is being used in a marine environment to collect temperature data for aquatic animal behaviour monitoring purposes.

How to Order Minilog12

When ordering the Minilog12, please specify the following:

- Product name [ie. TR or TX],
- Required standard temperature range or if a custom set up is needed,
- If additional memory is needed, &
- If a PC interface box is needed.

When What's Beneath the Surface Counts



sales@vemco.com

Temperature Loggers for Streams (Including NFFR)

- (a) March-April Pre-season Calibration

**Summary of March-April 2003 Calibrations
PG&E Vemco Minilab12 Temperature Logger**

4/03/2003 Cal Bath		2190	2192	2193	2197	2198	2199	2200	2201	2202	2203	2204
Time	Temp	difference										
9:03	25.03	0.04	0.04	0.03	0.17	0.03	0.04	0.03	0.04	0.00	-0.17	0.04
9:28	20.03	0.05	0.06	0.08	0.18	0.04	0.06	0.05	0.06	0.03	-0.16	0.07
10:18	15.02	0.02	0.03	0.04	0.16	0.02	0.02	0.03	0.02	-0.01	-0.21	0.05
10:56	10.22	0.02	0.03	0.04	0.15	0.03	0.01	0.01	0.01	-0.02	-0.24	0.05
11:34	5.04	0.01	0.03	0.02	0.07	0.02	0.00	0.00	0.00	-0.01	-0.25	0.03

4/03/2003 Cal Bath		2205	2207	2208	2209	2554	2555	2556	2557	2558	2559	2561
Time	Temp	difference										
9:03	25.03	0.06	0.05	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.02	0.03
9:28	20.03	0.05	0.05	0.06	0.06	0.08	0.05	0.06	0.06	0.09	0.06	0.06
10:18	15.02	0.02	0.01	0.04	0.04	0.07	0.03	0.05	0.06	0.08	0.06	0.06
10:56	10.22	0.01	0.01	0.03	0.03	0.06	0.03	0.04	0.04	0.07	0.06	0.05
11:34	5.04	0.01	0.00	0.03	0.00	0.03	-0.01	0.03	0.01	0.06	0.07	0.05

4/03/2003 Cal Bath		2562	2563	2564	2565	2566	2568	2569	2570	2571	2572	2573
Time	Temp	difference										
9:03	25.03	0.04	0.03	0.02	0.17	0.17	0.05	0.02	0.36	0.00	0.04	0.01
9:28	20.03	0.08	0.07	0.06	0.18	0.20	0.08	0.04	0.15	0.05	0.08	0.07
10:18	15.02	0.06	0.06	0.06	0.18	0.19	0.05	0.06	0.02	0.05	0.06	0.05
10:56	10.22	0.06	0.04	0.05	0.15	0.17	0.04	0.04	0.00	0.03	0.05	0.05
11:34	5.04	0.03	0.02	0.04	0.05	0.05	0.01	0.04	0.00	0.01	0.03	0.04

4/03/2003 Cal Bath		2903	2904	2906	2907	2908	2909	2910	2911	2912	2913	2914
Time	Temp	difference										
9:03	25.03	0.05	0.04	0.14	0.02	0.16	0.02	0.03	0.16	0.03	-0.03	0.00
9:28	20.03	0.09	0.08	0.17	0.07	0.18	0.05	0.05	0.19	0.06	0.07	0.06
10:18	15.02	0.04	0.04	0.17	0.06	0.17	0.03	0.02	0.18	0.04	0.08	0.06
10:56	10.22	0.02	0.02	0.14	0.04	0.15	0.02	0.00	0.16	0.04	0.08	0.06
11:34	5.04	-0.05	-0.02	0.04	0.01	0.04	0.00	-0.05	0.06	0.01	0.07	0.04

**Summary of March-April 2003 Calibrations
PG&E Vemco Minilab12 Temperature Logger**

4/03/2003 Cal Bath		2915	2916	2917	2918	2919	2920	2921	2922	3040	3041	3043
Time	Temp	difference										
9:03	25.03	-0.01	0.15	0.01	0.00	-0.12	0.00	0.00	-0.01	0.19	0.07	0.19
9:28	20.03	0.07	0.18	0.05	0.04	0.03	0.06	0.06	0.05	0.18	0.07	0.18
10:18	15.02	0.05	0.18	0.04	0.05	0.05	0.07	0.06	0.05	0.15	0.03	0.16
10:56	10.22	0.05	0.15	0.04	0.06	0.03	0.06	0.05	0.05	0.11	0.01	0.12
11:34	5.04	0.05	0.03	0.00	0.06	-0.10	0.06	0.06	0.03	0.00	-0.03	0.00

4/03/2003 Cal Bath		3044	3045	3048	3049	3050	3051	3052	3053	3054	3055	3056
Time	Temp	difference										
9:03	25.03	0.06	0.19	0.05	0.06	0.04	0.07	0.06	0.05	0.06	0.05	0.05
9:28	20.03	0.08	0.18	0.09	0.06	0.06	0.08	0.06	0.07	0.09	0.07	0.05
10:18	15.02	0.03	0.15	0.03	0.04	0.02	0.03	0.05	0.05	0.05	0.04	0.04
10:56	10.22	0.02	0.11	0.01	0.01	-0.01	0.02	0.05	0.05	0.04	0.04	0.05
11:34	5.04	-0.03	0.00	-0.02	-0.02	-0.04	0.00	0.04	0.04	0.04	0.05	0.04

4/03/2003 Cal Bath		3057	3058	3059	3060	3061	3062	3063	3064	3065	3066	6998
Time	Temp	difference										
9:03	25.03	0.18	0.07	0.06	0.07	0.06	0.06	0.19	0.05	0.19	-0.16	0.03
9:28	20.03	0.19	0.08	0.07	0.09	0.07	0.06	0.19	0.08	0.20	0.06	0.07
10:18	15.02	0.17	0.05	0.05	0.06	0.05	0.03	0.17	0.06	0.18	0.12	0.05
10:56	10.22	0.15	0.03	0.04	0.05	0.04	0.03	0.16	0.06	0.17	0.10	0.02
11:34	5.04	0.05	0.04	0.04	0.05	0.04	0.02	0.07	0.06	0.07	-0.03	-0.02

4/03/2003 Cal Bath		6999	7000	7001	7002	7003	7004	7005	7006	7007	7008
Time	Temp	difference									
9:03	25.03	0.04	0.17	0.04	0.01	0.01	0.03	0.03	0.17	0.01	0.02
9:28	20.03	0.06	0.19	0.07	0.06	0.11	0.08	0.08	0.18	0.05	0.06
10:18	15.02	0.04	0.16	0.04	0.04	0.04	0.05	0.06	0.14	0.03	0.03
10:56	10.22	0.01	0.12	0.02	0.04	0.00	0.04	0.03	0.11	0.02	0.02
11:34	5.04	-0.04	0.01	0.00	0.03	-0.06	0.01	0.00	0.00	-0.02	-0.02



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2190
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2192
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2193
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2197
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2198
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2199
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2200
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2201
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2202
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2202
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2203
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2204
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2205
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2207
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2208
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2209
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2554
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2555
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2556
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2557
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2558
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2559
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2561
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2562
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2563
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2564
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2565
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2566
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2568
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2569
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2570
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2571
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2572
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2573
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2903
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2904
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2906
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2907
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2908
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2909
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2910
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler:
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2911
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2912
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2913
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2914
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2915
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2916
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2917
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

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Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2918
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2919
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2920
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2921
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	2922
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3040
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3041
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3043
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3044
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3045
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3048
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3049
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3050
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3051
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results-Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3052
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3053
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3054
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3055
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3056
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3057
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3058
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vernco
Model No.	Minilog12
Instrument Identification No.	3059
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3060
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3061
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3062
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3063
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3064
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3065
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	3066
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	6998
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	6999
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7000
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7001
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7002
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7003
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7004
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vernco
Model No.	Minilog12
Instrument Identification No.	7005
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7006
Accuracy as Received	Does not meet manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7007
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7008
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	02-03 Preseason cal.xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: March-April 2003

Calibrated by:

EMK

Temperature Loggers for Streams (Including NFFR)

(b) October 2003 Post-season Calibration

Note: Units with Serial number 2XXX-3XXX were sent to VEMCO for battery replacement and re-calibration. See letters from EMK to VEMCO, dated October 13 and 30, 2003)

Memorandum

Date: October 13, 2003

File #:

RMA # 2003 10 07 GC 0083

To: VEMCO Ltd.

From: Eric Kenzler

Subject: Minilog re-battery



VEMCO Service Department:

Please renew the batteries in the enclosed 34 Minilog 12-TR units and return them to me at;

Pacific Gas and Electric Company
Technical and Ecological Services
3400 Crow Canyon Road
San Ramon, California 94583

C/O Eric Kenzler

You may send an invoice for payment C/O Accounts Payable at the same address.

Please reference Repair & Return Order #3500427641.

Serial numbers of the enclosed data loggers are:

2190	2565	2205	2903	2557	2912
2192	2668	2207	2904	2558	2913
2193	2570	2208	2907	2559	2914
2199	2571	2209	2908	2560	2915
2201	2572	2554	2909	2562	2917
2202	2573	2555	2910		

Please call me at (925) 866-5806 if you have any questions about the order.

Thank you,

A handwritten signature in black ink, appearing to read "Eric Kenzler".

Eric Kenzler
Pacific Gas and Electric Co.
Emk1@pge.com

ADD \$18 each
TO Recalibrate
10-22-03
612.

Memorandum

Date: October 30, 2003
To: VEMCO Ltd.
From: Eric Kenzler
Subject: Minilog re-battery

File #:



VEMCO Service Department:

Please renew the batteries and re-calibrate the enclosed 42 Minilog 12-TR units and return them to me at;

Pacific Gas and Electric Company
Technical and Ecological Services
3400 Crow Canyon Road
San Ramon, California 94583

C/O Eric Kenzler

You may send an invoice for payment C/O Accounts Payable at the same address.
Please refer to Repair & Return Order #3500438691.
Serial numbers of the enclosed data loggers are:

2197	2564	2921	3049	3057	3065
2198	2666	2922	3050	3058	3066
2200	2569	3040	3051	3059	
2203	2906	3041	3052	3060	
2204	2911	3043	3053	3061	
2556	2918	3044	3054	3062	
2561	2919	3045	3055	3063	
2563	2920	3048	3056	3064	

Please call me at (925) 866-5806 if you have any questions about the order.

Thank you,

Eric Kenzler
Pacific Gas and Electric Co.
Emk1@pge.com

**Summary of October 2003 Calibrations
PG&E Vemco Minilab12 Temperature Logger**

October 30, 2003 Cal Bath		9324	9327	9328	9329	9330	9331	9333	9334	9335	9353
Time End	Bath Temp	difference									
11:15	5.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.09	0.00
11:55	15.00	0.10	0.10	0.00	0.00	0.00	0.10	0.10	0.10	0.10	0.10
12:58	25.00	0.00	0.00	0.00	-0.10	-0.07	0.00	0.00	0.00	0.00	0.00

October 30, 2003 Cal Bath		9352	9351	9350	9349	9348	9345	9344	9342	9341	9340
Time End	Bath Temp	difference									
11:15	5.10	0.00	0.00	0.10	0.10	0.10	0.00	0.00	0.00	0.10	0.00
11:55	15.00	0.10	0.10	0.10	0.11	0.10	0.09	0.10	0.10	0.20	0.10
12:58	25.00	0.00	0.00	0.00	0.10	0.10	0.00	0.10	0.01	0.10	0.00

October 30, 2003 Cal Bath		9339	9338	9337	6998	6999	7000	7001	7002	7003	7004
Time End	Bath Temp	difference									
11:15	5.10	0.03	0.06	0.10	0.03	0.02	-0.01	0.04	0.02	0.00	0.03
11:55	15.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
12:58	25.00	0.10	0.00	0.00	-0.01	-0.03	-0.03	0.05	0.05	-0.05	0.05

October 30, 2003 Cal Bath		7005	7006	7007	7008	9325	9326	9336	9346	9332	
Time End	Bath Temp	difference									
11:15	5.10	0.02	0.03	0.02	0.03	0.04	0.04	0.04	0.04	0.04	
11:55	15.00	0.10	0.04	0.09	0.10	0.10	0.10	0.10	0.00	0.10	
12:58	25.00	0.05	-0.05	0.05	0.03	0.05	0.05	0.15	-0.03	0.05	



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9324
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9327
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9328
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9328
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9329
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9330
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9331
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9333
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9334
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9335
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9353
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9352
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9351
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9350
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9349
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9348
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9345
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9344
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9342
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9341
Accuracy as Received	Does not meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	Adjusted calibration coefficient to meet manufacturer's spec
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9340
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9339
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9338
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vernco
Model No.	Minilog12
Instrument Identification No.	9337
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	6998
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	6999
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7000
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7001
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7002
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7003
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7004
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7005
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7006
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7007
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	7008
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9325
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9326
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.

Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9336
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating-temperature bath with circulator/heater and cooler.
Traceable Model® 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9346
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK



Technical and Ecological Services Calibration Report

Instrument Owner	TES Water Quality
Description	Vemco
Model No.	Minilog12
Instrument Identification No.	9332
Accuracy as Received	Meets manufacturer's spec $\pm 0.1^{\circ}\text{C}$
Maintenance Performed	None required
Calibration Results Raw data in Excel file	2003 Out Cal (3).xls

Standards used:

ThermoNeslab Model RTE17 circulating temperature bath with circulator/heater and cooler.
Traceable Model[®] 15-077-8 digital thermometer (traceable to NIST).

Standards are calibrated traceable to NIST, other national standards or physical constants, or calibrated using accepted ratio techniques.

Calibration Date: October 2003

Calibrated by:

EMK

**Temperature Loggers Internal Powerhouse
And Pressure Transducer Unit
Maintenance Record for 2003**

2003 Calibration Verification

Conducted by: Tim Sgraves

Date: 5/12/2003

Location: Paradise field lab

ASTM Instrument: ATSM Mercury thermometer
verified with Seamon Mini D832

2003 Calibration Accuracy - Water Bath

Deployment	Type	Pod No.	In-Date	Batteries	ASTM	Pod	Acc	ASTM	Pod	Acc	ASTM	Pod	Acc
Butt Valley	DP112	3682	05/23/03	New Alk	16.5	16.6	0.1	8.6	8.7	0.1	28.9	29.2	0.3
Caribou No1.	DP112	6215	05/23/03	New Alk	16.5	16.4	-0.1	8.6	8.5	-0.1	28.9	28.9	0.0
Belden	DP112	6752	05/23/03	New Alk	16.5	16.6	0.1	8.6	8.7	0.1	28.9	29.2	0.3
Rock Crk	DP112	6748	05/23/03	New Alk	16.5	16.5	0.0	8.6	8.7	0.1	28.9	28.9	0.0
Caribou No2.	DP112	6277	05/23/03	New Alk	16.5	16.6	0.1	8.6	8.7	0.1	28.9	28.9	0.0
Poe	DP112	6643	05/30/03	New Alk	16.5	16.6	0.1	8.6	8.6	0.0	28.9	29.2	0.3
Cresta	DP112	6741	05/29/03	New Alk	16.5	16.7	0.2	8.6	8.8	0.2	28.9	29.2	0.3

Overall Mean	Op Range Mean
0.2	0.1
-0.1	-0.1
0.2	0.1
0.0	0.0
0.1	0.1
0.1	0.1
0.2	0.2
0.1	0.1

2003 Calibration Accuracy - Water Bath

Deployment	Type	Pod No.	In-Date	Batteries	ASTM	Pod	Acc	ASTM	Pod	Acc	ASTM	Pod	Acc
NF1	CR510	2326	6/12/2003	Gell 33ah	16.5	16.5	0.0	8.6	8.7	0.1	28.9	28.8	-0.1
HB1	CR510	8573	5/28/2003	Gell 33ah	16.5	16.4	-0.1	8.6	8.7	0.1	28.9	28.9	0.0
BC3	CR510	8452	5/28/2003	Gell 33ah	16.5	16.4	-0.1	8.6	8.5	-0.1	28.9	29.0	0.1
NF4	CR510	4132	5/28/2003	Gell 33ah	16.5	16.4	-0.1	8.6	8.6	0.0	28.9	28.8	-0.1
YC1	CR510	2325	6/12/2003	Gell 33ah	16.5	16.6	0.1	8.6	8.6	0.0	28.9	28.8	-0.1
MilkRanch	CR510	3809	5/29/2003	Gell 33ah	16.5	16.5	0.0	8.6	8.6	0.0	28.9	28.8	-0.1
Bucks	CR510	2324	5/29/2003	Gell 33ah	16.5	16.6	0.1	8.6	8.7	0.1	28.9	28.9	0.0
Grizzly	CR510	8572	6/12/2003	Gell 33ah	16.5	16.5	0.0	8.6	8.5	-0.1	28.9	28.9	0.0

Mean	Mean
0.0	0.0
0.0	0.0
0.0	-0.1
-0.1	-0.1
0.0	0.1
0.0	0.0
0.1	0.1
0.0	0.0
0.0	0.0

No post deployment verification performed, all units verified during operation using insitu instrumentation (YSI30). No drift in thermistor observed.

Telemetered Temperature Loggers

NF56 and NF57

Calibration and Repair Record

From April 2002 – May 2003

Note: Post-season 2003 calibration was made by comparison to in-situ units installed at each gage stations, the results were shown in the Annual Report (inserts from the report attached)

Calibration (Raw Reading)				Calculation		Notes	Microdaq Datalogger S/N
Low Input	Desired Low	High Input	Desired High	M	B		
1.911	2	9.552	10	-0.9551	0.0008	This step was used to correct for <i>Individual</i> Datalogger input differences. This enabled us to use a stock slope and offset when correcting to engineering units.	10730
1.912	2	9.56	10	0.9560	0.0000		10729
1.908	2	9.589	10	0.9601	-0.0122		10680
0	2	30	10	3.7500	-7.5000	Stock M & B For Microdaq dataloggers	

RTD Sensor Calibration (* NIST Traceable)						System Scaling							Transmitter died after suspected lightening strike See re-calibration on next worksheet.	
Calibration Date	Location	Calibration Point	RTD & Xmtr display	RTD Deviation	Reference Standard	Date	Shunt Calibration Point (°C)	Indication on Transmitter display (°C) *	Current (ma)	Local Logger Reading*	End reading at Rock Creek (°C) *	Deviation (°C)		Tolerance
04/15/02	NF - 56					04/23/02	0.00	0.06	4.02	0.04	0.03	0.03		+/- 0.1°C
		10.00	10.04	0.04	TSTD008		10.00	10.04	9.37	10.07	9.99	-0.01		
		12.50	12.54	0.04	TSTD008		----	----	----	----	----	----		
		15.00	15.06	0.06	TSTD008		14.86	14.92	11.96	14.93	14.82	-0.04		
		17.50	17.55	0.05	TSTD008		----	----	----	----	----	----		
		19.99	20.04	0.05	TSTD008		20.02	20.07	14.70	20.06	19.95	-0.07		
		22.50	22.54	0.04	TSTD008		----	----	----	----	----	----		
		25.00	25.06	0.06	TSTD008		24.90	24.96	17.30	24.94	24.84	-0.06		
							29.80	29.86	19.92	29.85	29.74	-0.06		
	NF - 57					04/23/02	0.03	0.05	4.03	0.06	0.06	0.03	+/- 0.1°C	
		10.00	9.98	-0.02	TSTD008		10.02	10.04	9.36	10.05	10.05	0.03		
		12.50	12.48	-0.02	TSTD008		----	----	----	----	----	----		
		15.00	14.98	-0.02	TSTD008		14.88	14.92	11.95	14.91	14.91	0.03		
		17.50	17.48	-0.02	TSTD008		----	----	----	----	----	----		
		19.99	19.98	-0.01	TSTD008		20.04	20.05	14.69	20.04	20.07	0.03		
		22.50	22.48	-0.02	TSTD008		----	----	----	----	----	----		
		25.00	24.99	-0.01	TSTD008		24.91	24.96	17.31	24.96	24.96	0.05		
							29.81	29.84	19.91	29.83	29.82	0.01		

RTD Sensor Calibration (* NIST Traceable)								
Calibration Date	Location	Calibration Point	RTD & Xmtr display	RTD Deviation	Current Reading (ma)	Local Logger Reading*	Local Logger Deviation	Reference Standard
05/16/02	NF - 56 at TES lab							
		0.00	0.02	0.02	4.00	0.01	0.01	TSTD008
		4.99	5.04	0.05	6.69	5.05	0.06	TSTD008
		10.02	10.07	0.05	9.37	10.07	0.05	TSTD008
		15.03	15.07	0.04	12.04	15.07	0.04	TSTD008
		20.03	20.06	0.03	14.70	20.05	0.02	TSTD008
		25.02	25.07	0.05	17.37	25.07	0.05	TSTD008
		30.03	30.07	0.04	20.06	30.10	0.07	TSTD008

RTD Sensor Calibration (* NIST Traceable)									
Calibration Date	Location	Cal Standard	Micro-Daq Local Logger	RTD & Xmtr display	RTD Deviation	Current Reading (ma)	Caribou Reading	(RTD) Caribou Deviation	Reference Standard
10/28/02	NF - 57								
		0.19	0.19	0.16	-0.03	4.09	0.16	-0.03	TSTD008
		4.98	4.98	4.97	-0.01	6.63	4.71	-0.27	TSTD008
		9.97	9.97	9.98	0.01	9.28	9.63	-0.34	TSTD008
		14.97	14.97	14.96	-0.01	11.98	14.49	-0.48	TSTD008
		19.98	19.98	19.97	-0.01	14.65	19.38	-0.60	TSTD008
		24.99	24.99	24.99	0.00	17.32	24.27	-0.72	TSTD008
		29.89	29.89	29.89	0.00	19.93	29.04	-0.85	TSTD008

RTD Sensor Calibration (* NIST Traceable)									
Calibration Date	Location	Cal Standard	Micro-Daq Local Logger	RTD & Xmtr display	RTD Deviation	Current Reading (ma)	Rock Creek Reading	Rock Creek Deviation	Reference Standard
10/29/02	NF - 56								
		0.09	0.09	0.11	0.02	4.07	0.12	0.03	TSTD008
		4.94	4.94	4.99	0.05	6.66	4.98	0.04	TSTD008
		9.97	9.97	10.00	0.03	9.34	10.02	0.05	TSTD008
		15.01	15.01	15.02	0.01	12.00	15.02	0.01	TSTD008
		20.02	20.02	20.03	0.01	14.69	20.04	0.02	TSTD008
		25.06	25.06	25.04	-0.02	17.36	25.04	-0.02	TSTD008
		29.88	29.88	29.88	0.00	19.94	30.00	0.12	TSTD008

RTD Sensor Calibration (* NIST Traceable)								
Calibration Date	Location	Cal Standard	RTD & Xmtr display	RTD Deviation	Current Reading (ma)	Caribou Reading	(RTD) Caribou Deviation	Reference Standard
05/20/03	NF - 57							
		0.59	0.61	0.02	4.31	0.66	0.07	TSTD012
		5.23	5.32	0.09	6.85	5.31	0.08	TSTD012
		10.21	10.27	0.06	9.49	10.29	0.08	TSTD012
		15.35	15.39	0.04	12.20	15.39	0.04	TSTD012
		20.21	20.27	0.06	14.80	20.19	-0.02	TSTD012
		25.29	25.33	0.04	17.50	25.32	0.03	TSTD012
		29.52	29.55	0.03	19.75	29.52	0.00	TSTD012

RTD Sensor Calibration (* NIST Traceable)								
Calibration Date	Location	Cal Standard	RTD & Xmtr display	RTD Deviation	Current Reading (ma)	Rock Creek Reading	Rock Creek Deviation	Reference Standard
05/20/03	NF - 56							
		0.79	0.77	-0.02	4.42	0.75	-0.04	TSTD012
		5.16	5.11	-0.05	6.74	5.07	-0.09	TSTD012
		10.07	10.01	-0.06	9.34	9.99	-0.08	TSTD012
		15.03	14.97	-0.06	11.97	14.91	-0.12	TSTD012
		19.94	19.91	-0.03	14.63	19.86	-0.08	TSTD012
		24.94	24.91	-0.03	17.28	24.84	-0.10	TSTD012
		29.51	29.43	-0.08	19.69	29.37	-0.14	TSTD012

Rock Creek – Cresta Project

FERC Project No. 1962

Water Temperature Monitoring of 2002

FERC License Condition No. 4C

Final May 21, 2003

Prepared By:



***Pacific Gas and
Electric Company***

CARB2 and CARB2B data recorders. As indicated by this data, the agreement between the synoptic profiles and data from CARB2 located in the penstock is very good during periods of powerhouse operation. The data also indicates that the effective withdrawal depth associated with the Caribou No. 2 Intake is from the surface to 4,115 ft (USGS datum).

3.2.2.3 Performance of telemetry stations

Real-time temperature (telemetry) systems were installed in the gaging stations located at NF-56 and NF-57. Temperatures were measured at 30-minute intervals and stored locally on a data logger as well as being transmitted through SCADA to the Rock Creek and Caribou Powerhouse Switching Centers. The temperature data were processed for the daily average value, mid-night to mid-night, and if temperature levels exceeded 20°C on two consecutive days, a signal alerted operators and the temperature condition was reported to ERC and FS personal. An appropriate course of action was then developed in order to try and maintain daily average temperatures below 20°C at NF-56 and/or NF-57.

In order to evaluate the performance of the two telemetry station sensors, data from the in-situ recorders installed at the telemetry location were used to document performance. Figure 3-28A compares daily average temperatures from station NF-56. The evaluation of telemetry data from the NF-56 station indicated that the average difference was 0.10°C, with a maximum absolute difference of 0.21°C. This level of discrepancy is well within the margin of combined instrument error. Figure 3-28B compares daily average

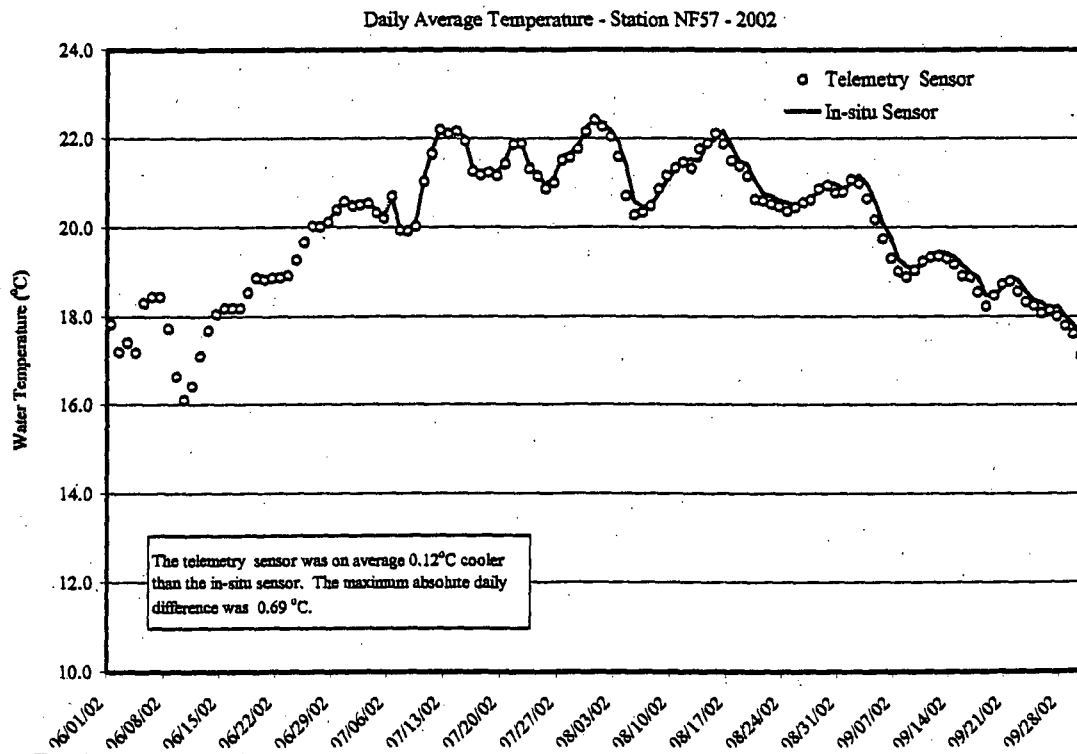
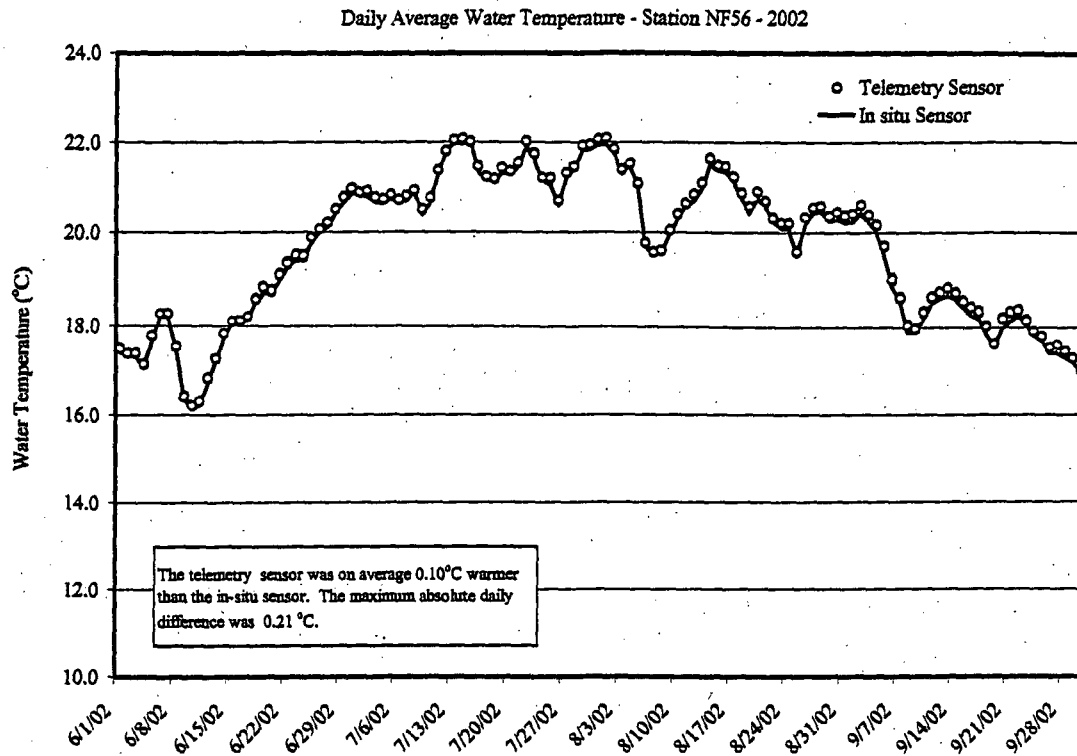


Figure 3-28. Comparison of daily average temperatures from telemetry sensors with insitu recorders – 2002.

Rock Creek – Cresta Project

FERC Project No. 1962

Results of 2003 Water Temperature Monitoring

And Special Caribou Powerhouse Test

Final Report

FERC License Condition No. 4C

FERC License Condition No. 5

Final May, 2004

Prepared By:



***Pacific Gas and
Electric Company***

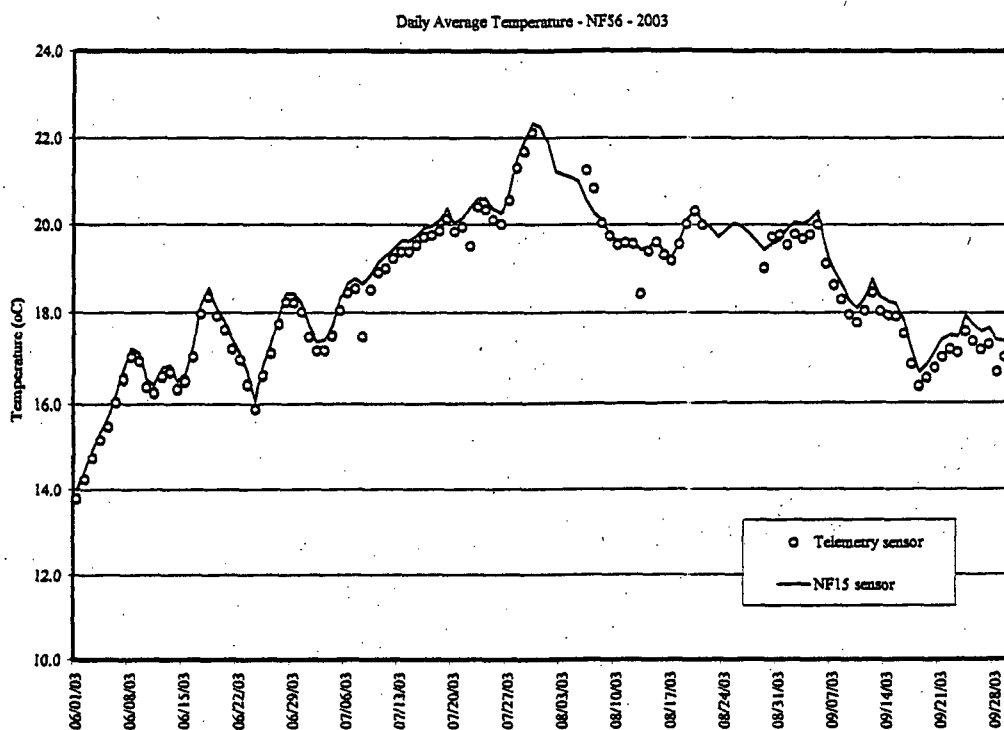
course of action was then developed in order to try and maintain daily average temperatures below 20°C at NF-56 and/or NF-57.

In order to evaluate the performance of the two telemetry station sensors, data from the in-situ recorders installed at the telemetry location were used to document performance. In 2003, lightning struck the NF-56 telemeter sensor twice. Each strike caused a malfunction of the telemetered readings and resulted in two weeks of time (7/31-8/5 and 8/22-8/28) with large errors compared with the in-situ recorder. ERC was immediately notified of these events, and the damaged sensor was replaced within a one-week period.

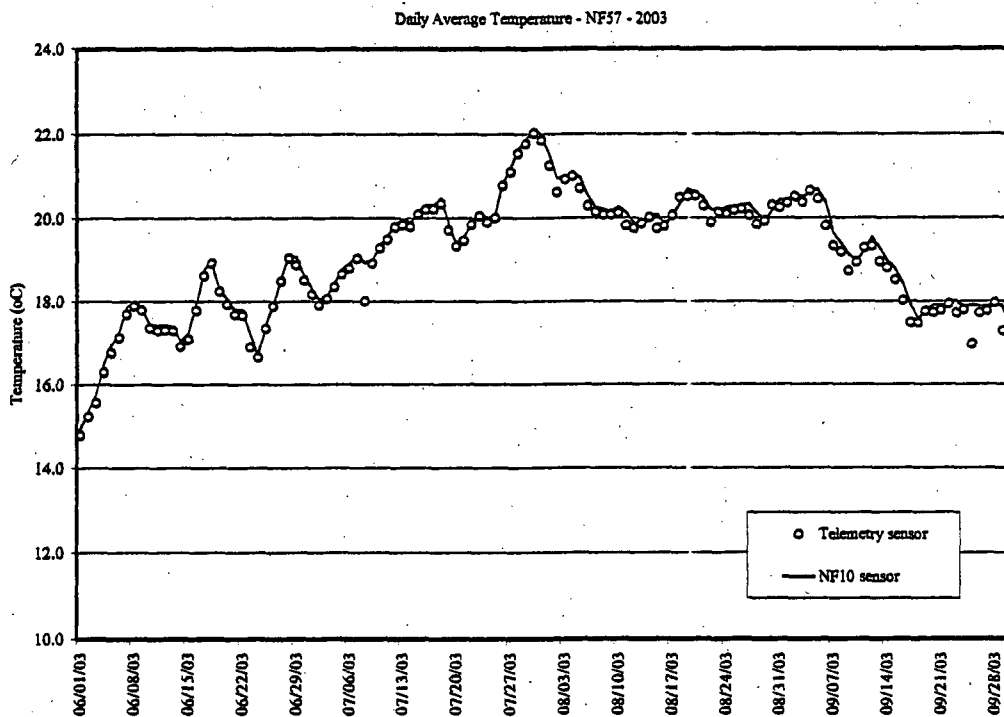
Figure 3-29A compares daily average temperatures from station NF-56. The evaluation of telemetry data from the NF-56 station (exclusive of the malfunctioning period) indicated that the average difference was 0.24°C, with a maximum absolute difference of 1.22°C. Figure 3-29B compares daily average temperatures from station NF-57. The evaluation of data from the NF-57 station indicated that the average difference was 0.15°C, with a maximum absolute difference of 0.95°C. Periodic performance tests were conducted at each station using a temperature bath in May, 2003.

3.2.2.4 Effect of inflow from Bucks Lake system on water temperatures in the NFFR

The Bucks Lake system delivers relatively cool water to the lower portion of the Rock Creek Reach. Two temperature evaluations were performed on data from stations located upstream and downstream of inflows from the Bucks system. The first evaluation focused on inflow from



A. Station NF-56.



B. Station NF-57.

Figure 3-29. Comparison of daily average temperatures from telemetry sensors with insitu recorders – 2003.