Illinois Environmental Protection Agency
Bureau of Water Document Control No.: 096

STANDARD OPERATING PROCEDURE FOR MONITORING TEMPERATURE IN REFRIGERATORS AND FREEZERS

Approval:

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1. 0 Scope and Application:

1.1 This SOP covers the monitoring of temperatures in refrigerators and freezers used for the chilling and storage of environmental samples. Currently, the SOP is applicable in the BOW DWPC Surface Water and Field Operations Sections and the BOW DPWS Groundwater Section.

1.2 The applicable range of the digital thermometer used in this procedure is $+1\ ^{o}C$ to $+7\ ^{o}C$ for refrigerators and $-50^{o}C$ to $-1^{o}C$ for freezers.

2.0 Summary of Method:

2.1 An electronic digital thermometer with high/low temperature alarm function is used to continuously monitor temperatures of refrigerators and freezers where environmental samples are chilled or stored. An alarm sounds if refrigerator/freezer temperatures deviate from the established temperature ranges.

3.0 Interferences and Corrective Action:

3.1 Placement of the thermometer sensor near a source of incoming refrigerated air may result in temperature readings that are not representative of the 'average" temperature inside the refrigerator/freezer or of the temperature of stored samples See Section 9.5 for corrective action.

3.2 Exposure of the digital instrument module part of the thermometer to extreme temperatures or to shock could result in loss of calibration or failure of the instrument. Check the calibration of the thermometer annually, or when the digital instrument module has been exposed to extreme temperature or to shock.

3.3 Several refrigerators and freezers in Bureau of Water field offices are located in storage areas that are not normally occupied, thus, alarms are not likely to be heard. See Section 9.10 for corrective action.

4.0 Safety:

4.1 Follow normal office and laboratory safety procedures.

4.2 The ethylene glycol in the vial that contains the temperature sensor is mildly toxic. If the vial is broken and ethylene glycol leaks, it should be cleaned up using disposable paper towels and water. Proper personal protection, such as disposable gloves, should be employed.

5.0 Equipment and Supplies:

5.1 Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer.

5.2 Refrigerator/Freezer Monitoring and Maintenance Logbook. All operational problems and repairs to the refrigerator/freezer and the thermometer must be recorded in black ink in a bound logbook**.** Assign each refrigerator and freezer a unique number and always use the same thermometer in conjunction with the designated refrigerator or freezer. A single logbook, divided into sections for each refrigerator or freezer, could be used in each regional office.

5.3 A reference thermometer that is calibrated against an NIST-traceable thermometer. Annually, each refrigerator/freezer and digital thermometer must be calibrated against a reference thermometer provided by the BOW QAO.

6.0 Preventative Maintenance:

6.1 Follow instrument manufacturers instructions for operation and maintenance as detailed in the Fisher Scientific Model New 06-664-11 Digital Refrigerator/Freezer Thermometer Instruction Manual.

6.2 Exposure of the digital instrument module part of the thermometer to extreme temperatures or to shock could result in loss of calibration or failure of the instrument. The thermometer must be checked against an NIST-traceable reference thermometer after an exposure that may have caused damage to the instrument.

7.0 Sample Collection, Preservation and Holding Time:

7.1 Environmental samples must be chilled to and stored at appropriate preservation temperatures. The range for samples that require refrigeration is $4^{o}C+2^{o}C$, or between $2^{o}C$ and $6^{o}C$. Samples that require freezing must be stored at less than $0^{o}C$. The procedures in this SOP will help ensure and document that samples are chilled to and stored within the appropriate temperature ranges.

8.0 Calibration and Standardization:

8.1 The Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer was factory calibrated against NIST instrumentation. This calibration complies with the requirements of ISO 9000 Certification. The Certificate of Calibration should be affixed to the first page of the Refrigerator/Freezer Monitoring and Maintenance Logbook. Once calibrated, the thermometer should maintain its accuracy. Electronics change little over time, but there is no way to determine how long calibration will be maintained.

8.2 Check the calibration of the thermometer against an NIST-traceable thermometer provided by the BOW QAO, annually, or when the digital instrument module has been exposed to extreme temperature or to shock.

9.0 Procedure for Monitoring the Temperature of a Refrigerator or Freezer:

9.1 Initial set-up of The Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer. **Note:** Record the date of the initial installation in the Refrigerator/Freezer Monitoring and Maintenance Logbook. **CAUTION:** After unpacking the thermometers from their shipping boxes, follow the instructions in Sections 9.1.1 – 9.1.3 in the order given. The thermometer unit must be reset using the RESET switch or by removing and reinstalling the battery each time the settings in Sections 9.1.1 – 9.1.3 are changed

9.1.1 Select Celsius temperature units by setting the **[C°/F°] Switch** on the back of the thermometer to **C°**.

9.1.2 Select the 60-second sampling cycle by setting the **[Fast/Normal] Sampling Switch** to **Normal**.

9.1.3 Install one AA size 1.5-volt battery in the digital instrument module (see Instruction Manual).

9.2 Setting the high/low temperature alarm limits for use in *refrigerators*: Press **[Mode]** button to set the unit into the **Alarm Display Mode**.

9.2.1 Set the **High Temperature Alarm Limit** at
by pressing the **[HI]** button in 1° steps until +7 °C is displayed.

9.2.2 Set the **Low Temperature Alarm Limit** at
by pressing the **[LO]** button in 1° steps until +1 °C is displayed.

9.2.3 Press the **[Mode]** button once to reset the thermometer to the **Normal Display Mode** which displays the minimum and maximum temperatures over any period of time.

9.3 Setting the high/low temperature alarm limits for use in *freezers*: Press **[Mode]** button to set the unit into the **Alarm Display Mode**.

9.3.1 Set the **High Temperature Alarm Limit** at –1°C by pressing the **[HI]** button in 1° steps until –1°C is displayed.

9.4.2 It is probably not necessary to set the low temperature alarm, since any temperature that keeps samples frozen is acceptable.

9.4.3 Press the **[Mode]** button once to reset the thermometer to the **Normal Display Mode** which displays the minimum and maximum temperatures over any period of time.

9.4 Connect the temperature sensor to the digital instrument module using the supplied 10-ft.-long cable. Select a location for the bottle and sensor in the refrigerator or freezer that is representative of the average temperature conditions in the unit. Placement of the thermometer sensor near a source of incoming

refrigerated air may result in temperature readings that are not representative of the 'average" temperature inside the refrigerator/freezer or of the temperature of stored samples. **CAUTION: Heed the WARNING in the Instruction Manual, " Warranty will cease to be effective if cable is cut or shortened".**

9.5 Mount the thermometer display unit on the outside of the refrigerator/freezer in a convenient location using either the magnetic or Velcro^{R} fasteners (see Instruction Manual).

9.6 Allow the temperature of the bottle/sensor to stabilize to within the appropriate range of temperatures for the refrigerator or freezer. Slide the **[Alarm ON/OFF]** switch to the **ON** position.

9.7 The alarm will sound for one minute when the refrigerator/freezer temperature reaches the high or low temperature alarm limit. If the refrigerator/freezer is left unattended, the alarm will stop automatically after one minute to conserve power, but will issue a three second repeater "beep" sound every minute for up to 12 hours as a continued warning that the temperature has moved outside the alarm limits. The repeater alarm will continue to sound even if the temperature later returns to the allowed temperature band. If the unit is in the **Normal Display Mode** (as it should be at all times), the respective alarm indicator – either high or low – will flash continuously for up to 12 hours or until the alarm is deactivated.

9.8 If the alarm sounds, it should be deactivated temporarily by pressing either the **[HI]** or **[LO]** buttons located on the back of the unit. (Temporarily disabled means that the alarm is still active and will sound again if the temperature reached the high or low limits.) Check the current temperature on the thermometer display to determine if the refrigerator/freezer temperature is outside the appropriate limits (Section 9.2). **Note:** Record the alarm incident and the action taken Section 9.8.1, 9.8.2 or 9.8.3 in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

9.8.1 If the alarm does not sound again, and if the current temperature is within the acceptable range, it could have been a one-time temperature excursion of undetermined cause, and no further action is required. However, the temperature of the refrigerator/freezer unit should be monitored more closely for several days until the reason for the excursion is established. **Note:** Record the alarm incident and the temperature excursion in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

9.8.2 If the alarm continues to sound after being reset, and the current temperature is not within the acceptable range, adjust the refrigerator/freezer temperature up or down as appropriate following the manufacturer's instructions. Continue to monitor and the unit's temperature and to adjust as needed over the next several days. **Note:** Record the alarm incident and the action taken in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

9.8.3 If the alarm continues to sound after attempting adjustment of the unit into the acceptable temperature range, the refrigerator/freezer may need repair or replacement. Do not use the refrigerator/freezer for sample storage until it is capable of maintaining temperatures in the appropriate range. **Note:** Record the alarm incident and the action taken in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

9.9 Because The Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer has the high/low temperature alarm function, it may not be necessary to routinely read and record refrigerator/freezer temperatures. **However, several of the refrigerators and freezers in Bureau of Water field offices are located in storage areas that are not normally occupied, thus, alarms are not likely to be heard. The minimum and maximum temperatures should be read from the display each time these refrigerators/freezers are visited for sample or reagent storage**. The minimum and maximum temperatures over any period of time (the period of time will vary depending on when a refrigerator/freezer was last visited) are read from the display when it is in the **Normal Display Mode** (as it should be at all times). See Sections 9.8.1 and 9.8.2 for further instructions.

9.9.1 If the minimum and maximum temperatures displayed since the last visit have not exceeded the appropriate limits (Sections 9.2 and 9.3), no further action is necessary.

9.9.2 If either the minimum or maximum temperature has exceeded the appropriate limits (Section 1.2), read and record the minimum, the maximum and the current temperature along with the date in the Refrigerator/Freezer Monitoring and Maintenance Logbook. After recording the minimum and maximum temperatures, reset the both memories by pressing the **[Memory Clear]** button once. Investigate the cause of the temperature excursion and attempt to correct the situation following the procedures in Section 9.8. **Note:** Record the alarm incident, the date minimum and maximum temperatures were reset, and any further action taken in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

10.0 Data Analysis and Calculations: Not Applicable.

11.0 Troubleshooting:

11.1 Return any malfunctioning Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer to the Fisher Scientific for repair or replacement.

12.0 Maintenance of Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer:

12.1 The Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer is not designed for field servicing. It should be returned to Fisher Scientific for any service required. The exception is battery replacement. Should the battery fail, it can be user replaced. See instructions in the Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer Instruction Manual. **Note:** Record battery replacement in the Refrigerator/Freezer Monitoring and Maintenance Logbook.

13.0 Method Performance:

13.1 The measurement range for the Fisher Scientific Model New 06-664-11 Electronic Digital Refrigerator/Freezer Thermometer when the temperature probe is attached is -50^{o}C to $+70^{o}$C. The resolution of the thermometer is 1^{o}C.

14.0 Quality Control and Corrective Action:

14.1 Annually, each refrigerator/freezer and digital thermometer must be calibrated against a reference thermometer that is calibrated against an NIST-traceable thermometer.

14.2 Corrective Action: Any nonconformance with the procedures in this SOP must be documented in the Refrigerator/Freezer Monitoring and Maintenance Logbook and the appropriate unit or section manager must be notified.

15.0 References:

American Public Health Association. 1992. *Standard Methods for the Examination of Water and Wastewater, 18th Edition.*

Combined Federal Register. 2001. 40 CFR Part 136. *Guidelines for establishing test procedures for the analysis of pollutants*.

Fisher Scientific. 2001. Fisher Scientific Model New 06-664-11 *Electronic Digital Refrigerator/Freezer Thermometer Instruction Manual*. Fisher Scientific, Inc

APPENDIX 1

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