Appendix H

Laboratory Information Management System (LIMS) Interface

This document describes the Laboratory Information Management System (LIMS) compatible interface of the Model 2020 Osmometer. This is a unidirectional interface with standardized serial port output messages, intended to aid the user in collecting and parsing data by computerized means for documenting instrument operation and test results.

The LIMS compatible interface utilizes the instrument serial port to output a series of delimited serial port strings, as defined in this document. These strings are only output after the user activates the LIMS mode via the setup menu. When active, all serial port output is suppressed and replaced by these strings. Output is unidirectional, initiated by the instrument. The user will need to supply a PC interface and software for the collection and processing of the serial port message strings.

This feature and its output are not in compliance with formal LIMS protocols. It is only intended to aid the user in interfacing with such a system.

Setup and activation

To activate the LIMS feature, use the instrument SETUP menu and scroll to select "**9. Select LIMS Out**". Use the keypad to change the condition setting to "**ON**", then exit to the main SETUP menu and save the configuration option.

To disable the LIMS feature, repeat this procedure and change the condition setting to "**OFF**".

Output format

Serial Port Status

Once the LIMS mode is activated, all standard serial port messaging is suspended (unless Factory mode or FLASH UPDATE mode has been activated). Each serial port message string is sent in ASCI II format. The data exchange of the serial port remains in accordance with ANSI/TIA/EIA standards.

LIMS Messages

Once the LIMS mode is activated, all serial port messaging is conducted using one of four message types: Status, Result, Calibration, and Error. Each field within the message is delimited with the vertical bar symbol "|", with no preceding or trailing spaces. The end of each message string is automatically terminated with an ASCII II carriage return and line feed (CR/LF).

Except for the last calibration message, all date and time stamps are at the time the serial message is issued. Date and time stamps contained on the instrument printout and in dedicated memory locations may differ slightly. The calibration message includes the last calibration date and time as stored in instrument memory.

- **Message Type: STATUS**
  The STATUS message is issued during the power-up sequence, upon entering and exiting standby, start and end of calibration, start and end of tray testing, and exit from instrument setup if any changes have been saved.

  The message is initiated using the uppercase letter 'S', contains a delimiter between each segment, and is terminated with CR/LF. The contents of the message include the message type, date, time, company name, model number, serial number, firmware version, machine state, incremental test counter, (65,535 maximum), NVRAM battery status, block bin value, sample bin value, and plateau mode in use.

Machine state: 0=Power-up, 1=Setting Changes Saved, 2=Standby, 3=Exit Standby, 4=Start Calibration, 5=Calibration Complete, 6=Start Tray, 7=Tray Complete.

Example: S|20060510|112632|Advanced Instruments Inc.|2020|03090845A|2.0|0|2364|1|6|5|1 <CR> <LF>

- **Message Type: RESULT**
  The RESULT message is issued at the end of each successful standard test. Calibration and Bin tests are not included, and do not have a corresponding message type.

  The message is initiated using the uppercase letter 'R', contains a delimiter between each segment, and is terminated with CR/LF. The contents of the message include the message type, date, time, company name, model number, serial number, turntable position number, sample ID if any, result, and units of measure.

  If a STAT test is run, the position number will be set to 99.

  Example: R|20060510|112632|Advanced Instruments Inc.|2020|03090845A|20|0123456789ABCDEFGHIJ|2000|mOsm/kg <CR> <LF>

- **Message Type: CALIBRATION**
  The CALIBRATION message is issued during the power-up sequence after the STATUS message, upon exit from instrument setup if any changes have been saved, at the start of calibration, and at the end of calibration after the operator accepts calibration.

  The message is initiated using the uppercase letter 'C', contains a delimiter between each segment, and is terminated with CR/LF. The contents of the message include the message type, date, time, company name, model number, serial number, last calibration date, last calibration time, calibration OK/not OK, high point calibration ON/OFF, and high point calibration OK/not OK.

  Example: C|20060510|112632|Advanced Instruments Inc.|2020|03090845A|20060510|80000|1|1|1 <CR> <LF>

- **Message Type: ERROR**
  The ERROR message is issued anytime the firmware issues a *Send-Error()* command.

  The message is initiated using the uppercase letter 'E', contains a delimiter between each segment, and is terminated with CR/LF. The contents of the message include the message type, date, time, company name, model number, serial number, turntable position number if any, sample ID if any, error code, and error message text.

  If the error occurs during a STAT test, the position number will be set to 99.

  Example: E|20060510|112632|Advanced Instruments Inc.|2020|03090845A|20|0123456789ABCDEFGHIJ|1000|Sample Pre Freeze <CR> <LF>

Data Collection

Basic Tools

- **AILink**
  The Advanced Instruments, Inc. utility, AILink may be used to collect and save the serial port messages via the AITerminal tab. This will create a text file that may be imported into third party software, such as Microsoft® Excel. Refer to Excel documentation on how to import a delimited text file. Once properly imported, you may use the heading information supplied above for each message type to read or sort the message strings.

- **HyperTerminal**
  Microsoft Windows® contains a utility for serial port communications that can be used to capture serial port output in much the same manner as described for AILink. Consult Microsoft® documentation and the instrument user's guide for information on setting up a HyperTerminal session.

- **Additional Third Party tools**
  Any terminal program designed to receive and save serial port data may be used as described above.

Advanced Tools

Many customers may wish to connect this instrument to a more advanced and automated data collection system. Such systems are beyond the capability of this document to describe in any detail, and Advanced Instruments, Inc. does not currently supply hardware or software to meet this requirement.

Delimiter Entry

A delimiter is a character used to specify the boundary between independent text fields. The delimiter programmed into the instrument firmware is available on the United States International keyboard and is known as the vertical bar or vertical line, and looks like this |. This character is part of the standard ASCI II character set using the HEX value 7C, decimal value 124, and Unicode value 0007C.

Programmers should use appropriate language code to identify this character when attempting to separate the information fields. Users of standard Windows® applications who are attempting to import a saved text file containing the LIMS strings will need to enter the delimiter in the program's dialog box for delimiter values. If you do not have a U.S. international keyboard or have remapped the keyboard to a foreign character set, then the delimiter may be entered using one of the methods below:

- **ALT Key Numeric Codes**
  To use this method you must have a numeric keypad, usually located on the right side of the keyboard. (You cannot use the numeric keys located across the top of the keyboard.) Place your cursor in the entry location of the application program, hold down the ALT key on the left side of the keyboard and enter the number 124 on the keypad. Release the ALT key and you should see the | symbol in the delimiter entry field.

- **Character Map Utility**
  If you are working from a laptop, notebook, or tablet PC that lacks a numeric keypad, then you may use the Microsoft Windows® Character Map Utility to enter the vertical bar symbol in the program delimiter field. This program is normally located in your programs/accessory/system tools area, but may need to be installed from the Windows® installation disk. Consult your Windows® help files on its use.