

Atlas Polymer Evaluation Products

CL400

CHEMILUME™

A N A L Y Z E R

USER'S GUIDE FOR INSTALLATION AND OPERATION

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1.0 WARNINGS AND PRECAUTIONS

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It is the responsibility of the purchaser of this equipment to establish and implement safety and health procedures or regulations which will protect the operator from unnecessary risks or hazards. Procedures for safe use of the supply gasses required by this instrument must be established in compliance with local safety codes and applicable regulatory agencies.

IMPAIRMENT OF SAFETY DEVICES

This instrument is equipped with safety devices to protect the operator and the equipment. Operation of the unit in any manner not prescribed by these instructions may impair the protection provided by the safety devices.

TOXIC FUME HAZARD

While each test cell in the instrument can accommodate only a very small amount of sample material, some polymer, ink or oil specimens may release toxic gas when heated to elevated temperatures. When locating the CL400 in a laboratory, this should be taken into consideration with respect to adequate ventilation or the implementation of a fume hood for repetitive testing of potentially toxic materials.



WARNING

This symbol indicates that there are special instructions or precautions in the user's manual regarding use of the instrument component to which the label is attached.



BURN HAZARD - Hot Surface

This symbol indicates that a burn hazard exists when using the instrument component to which the label is affixed. The operator must take proper precautions, such as protective clothing, and be aware of the proper procedures (marked by this symbol) in the user's manual for avoiding injury when using this part of the instrument.



RADIOACTIVITY HAZARD

The intensity standard used for calibration of the CL400 photomultiplier tubes (light sensors) is a radioactive emission source. While its output is extremely low (7-9 μCi), it must be handled, stored and disposed of according to applicable, local safety standards and regulatory policies. Special instructions in the manual are marked by this symbol.

EMERGENCY POWER DISCONNECT

In the event of an emergency, all power to the CL400 may be disconnected by unplugging the power cord from the back panel socket. The socket has been located near the top of the back panel for this purpose. Be sure to situate the CL400 according to the space requirements in Figure 1 to facilitate this procedure.

2.0 INSTRUMENT INSTALLATION

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This section describes how to unpack and set up your system hardware and what facilities are required for proper operation.

2.1 UNCRATING

The components of the CL400 ChemiLume are usually shipped in separate crates. Prior to accepting the shipment, carefully inspect the crates for signs of mishandling. Should hidden damage be found, immediately notify the carrier. Notify Atlas regarding the nature and extent of the damage so that the most appropriate corrective action can be determined.

Save all packing materials until the instrument is installed and operating properly.

2.2 SELECTING A LOCATION

Place the CL400 on a sturdy lab bench or other suitable table. Instrument space requirement is shown in Fig. 1.

The location must be convenient to electrical and gas supplies. Locate the computer beside the CL400 to facilitate operator access. Serial cable length should not exceed 7.6m (25 feet). Locate the chiller unit near the CL400 on or beneath the bench. Do not locate the CL400 in an area where stray electrical signals

(RFI/EMI) and vibrations might adversely affect computer operation. If vibration is unavoidable, install damping material of equal thickness beneath each foot of the table.

CAUTION! The CL400 weighs 39 kgs (85 lbs). The optional chiller weighs 74 kgs (163 lbs). Each should always be lifted by two individuals or one person using a hydraulic lift cart.

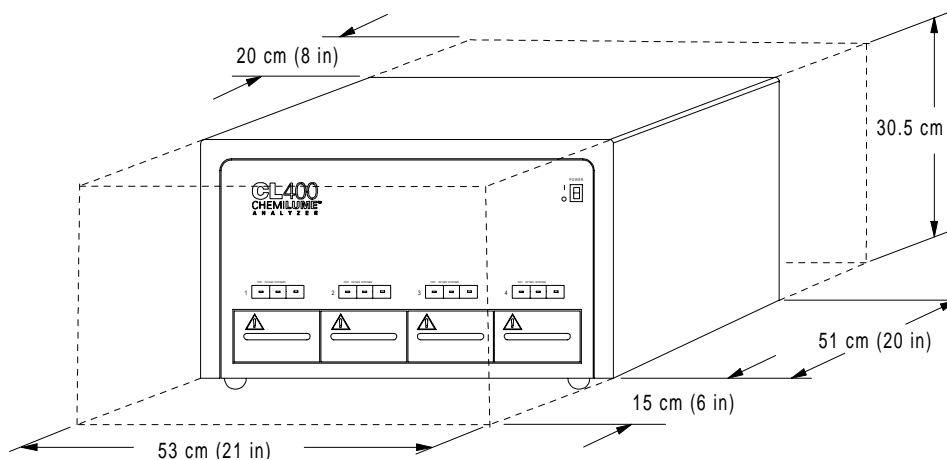


Figure 1 - Dimensions and Clearance Requirements

2.3 FACILITIES REQUIREMENTS

Environmental Requirements (CL400 Only)

Operating Temperature: 13°C (56°F) to 30°C (86°F); Humidity: 25-75%

Storage Temperature: 10°C (50°F) to 60°C (110°F); Humidity: 20-80%

Altitude: 2000 m (6560 ft.) Installation Category: II Pollution Degree: II

(Refer to computer manual and chiller manual for their environmental specifications.)

Electrical Requirements

CL400: 100Vac, 50Hz, 2.6 Amps max. (Refer to instrument label.)
115-120Vac*, 60Hz, 2.2 Amps max. (Refer to instrument label.)
200V, 50Hz, 1.3A Amps max. (Refer to instrument label.)
220-240Vac*, 50Hz, 1.1 Amps max. (Refer to instrument label.)
*±10% mains supply fluctuations

Fusing Requirements: 100Vac – 250V, T3.0A, Slow-Blow
115-120Vac – 250V, T2.8A, Slow-Blow
200-240Vac – 250V, T1.6A, Slow-Blow

Chiller: 100Vac, 50Hz (Fuse: 250Vac, 10A, IEC 127 Type T)
(Optional) 115-120Vac, 60Hz (Fuse: 250Vac, 10A, IEC 127 Type T)
220-240Vac, 50Hz (Fuse: 250Vac, 5A, IEC 127 Type T)

Computer: 100-220Vac, 50/60Hz Universal (switchable)

Gas Requirements

	Nitrogen (N ₂)	Oxygen (O ₂)
Input Pressure:	6.9 +2-0 kPa (1+0.3-0 PSI)	6.9 +2-0 kPa (1+0.3-0 PSI)
Flow Rate-Low:	25 +5-0 ml/min/cell (1.53 +0.3-0 in ³ /min/cell)	25 +5-0 ml/min/cell (1.53 +0.3-0 in ³ /min/cell)
Flow Rate-High:	50 +5-0 ml/min/cell (3.1 +0.3-0 in ³ /min/cell)	50 +5-0 ml/min/cell (3.1 +0.3-0 in ³ /min/cell)

Important: Standard bottle gas regulators are not adequate for regulating input pressure to 6.9 kPa (1 PSI). You must install secondary regulators for each gas type. Contact Atlas for recommendations. **The CL400 is not certified for use with gases other than nitrogen and oxygen.**

Water Chiller Minimum Requirements (if customer supplied)

Thermal Capacity: 480 watts @ 20°C ambient

Temperature Stability: ±0.5°C

2.4 SYSTEM REQUIREMENTS - User Supplied

This section describes the equipment requirements of the system computer and water chilling unit.

2.4.1 Computer Specifications

Type:	IBM Compatible Pentium 75 MHz
Operating System:	Windows 95
RAM:	16 Mb
Monitor:	15" Color (1024 x 768 capable)
Video Controller:	1024 x 768 mode or better
Hard Disk Drive:	540 Mb
Floppy Disk Drive:	3.5" 1.44 Mb
Parallel Port:	1
Serial Port:	1 (see note)
Input Devices:	Keyboard and mouse
Printer:	Hewlett Packard laser recom.

Note: Additional Serial Ports

If more than one CL400 ChemiLume is to be connected to the system computer, an additional serial interface card must be installed in the computer. Such serial cards are available with single or multiple ports.

Atlas recommends using a serial board having two ports, such as the Black Box Corporation Dual Port RS-232/422/485 Serial Interface or equivalent.

2.4.2 Water Chiller Specifications

The water chiller provides constant temperature cooling for the four PMTs (photomultiplier tubes) in the CL400. The PMTs are very sensitive and must not only be properly cooled but maintained at a stable operating temperature. The load on the chiller increases with CL400 test temperature, therefore the chiller must be capable of rapid response and tight temperature control.

Operating Environment:	5°C (41°F) - 40°C (104°F)
Thermal Capacity:	480 watts @ 20°C (68°F)
Temperature Stability:	±0.5°C
Flow Rate:	8.7 liters/min. (2.3 gal./min.)
Filtration:	5 microns or better

2.5 SYSTEM CONNECTIONS

Connect gas and water supplies first to eliminate leaks.

2.5.1 Gas Supply Connections

The CL400 requires nitrogen and oxygen for proper operation. These gases may be supplied from a central facility source or via bottled supply. In either case, secondary regulators are required for limiting input pressure to the CL400 to a maximum of 6.9 kPa (1 PSI). It is recommended that these be purchased from Atlas.

Make connections from your secondary gas regulators to the CL400 back panel inlets with rigid 1/8 inch I.D. x 1/4 inch O.D. teflon tubing (see Figs. 2 & 3). If you purchased the regulators and chiller from Atlas, all tubing is supplied. 6mm adapters are available from Atlas for gas connections. **Limit gas line lengths to 3m (10 ft.) maximum between the CL400 and supplies.**

After making connections, adjust the gas pressure to 9.7 kPa (1.4 PSI or 22 oz/in² on some regulators). This setting is above the 6.9 kPa (1 PSI) maximum input pressure since the CL400 gas flow is off. During operation the pressure will drop slightly due to flow. Readjust the gas regulators to 6.9 kPa (1 PSI) during operation to achieve the most accurate setting. Readjustment may also be required if you choose to run a test in only a single cell, rather than all four.

2.5.2 Water Chiller Connections

The chiller supplied by Atlas has 3/8" FNPT threaded inlet and outlet ports (Fig. 3). Install tubing compression connectors (similar to those on the back of the CL400). Use the supplied 3/16 inch I.D. x 1/4 inch O.D. teflon tubing to connect the chiller ports to the CL400 water ports (in Europe or Japan, use 6mm adapters). If an alternate tubing is used, it must be capable of withstanding 120 PSI at 86°F (828 kPa at 30°C). As much as possible, avoid unnecessary bends and minimize tubing lengths to promote cooling efficiency.

Fill the chiller with clean tap water (Fig. 3). DO NOT use deionized (D.I.) water. It will interact unfavorably with chiller and internal components and connections.

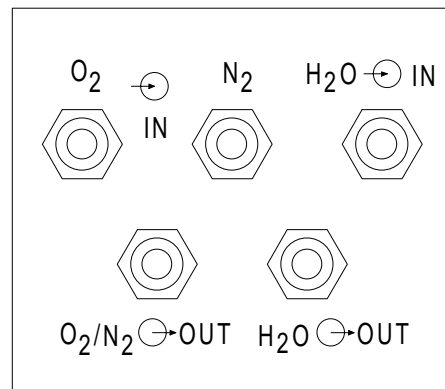


Figure 2 - CL400 Ports

2.0 INSTRUMENT INSTALLATION

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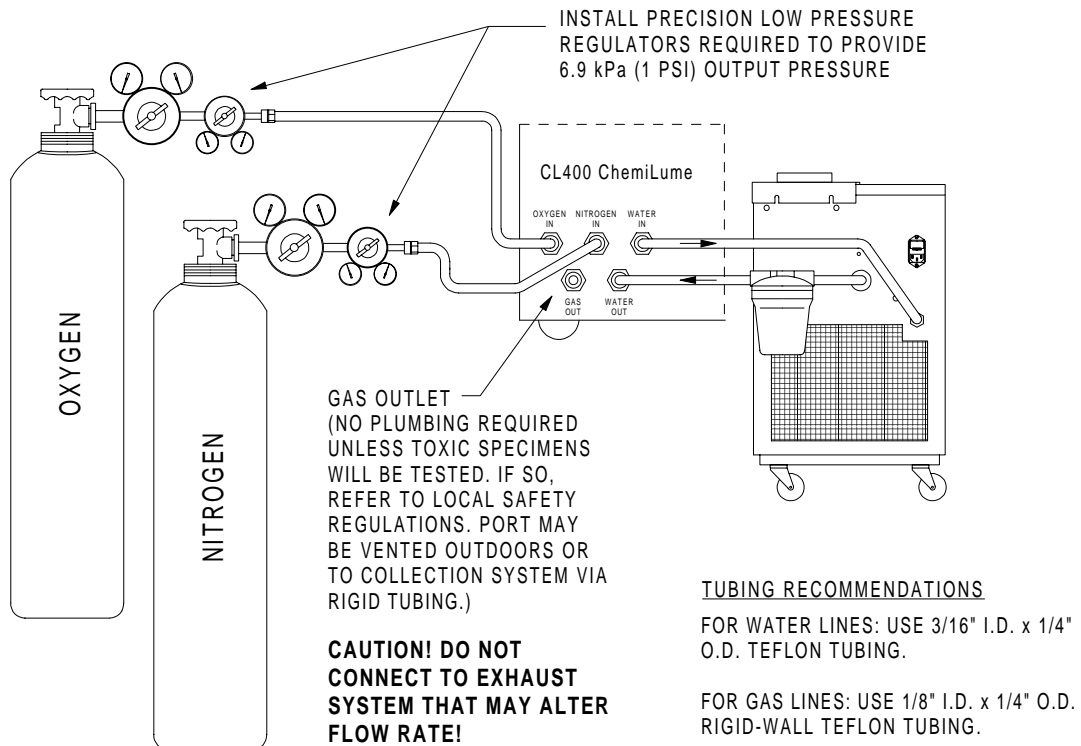
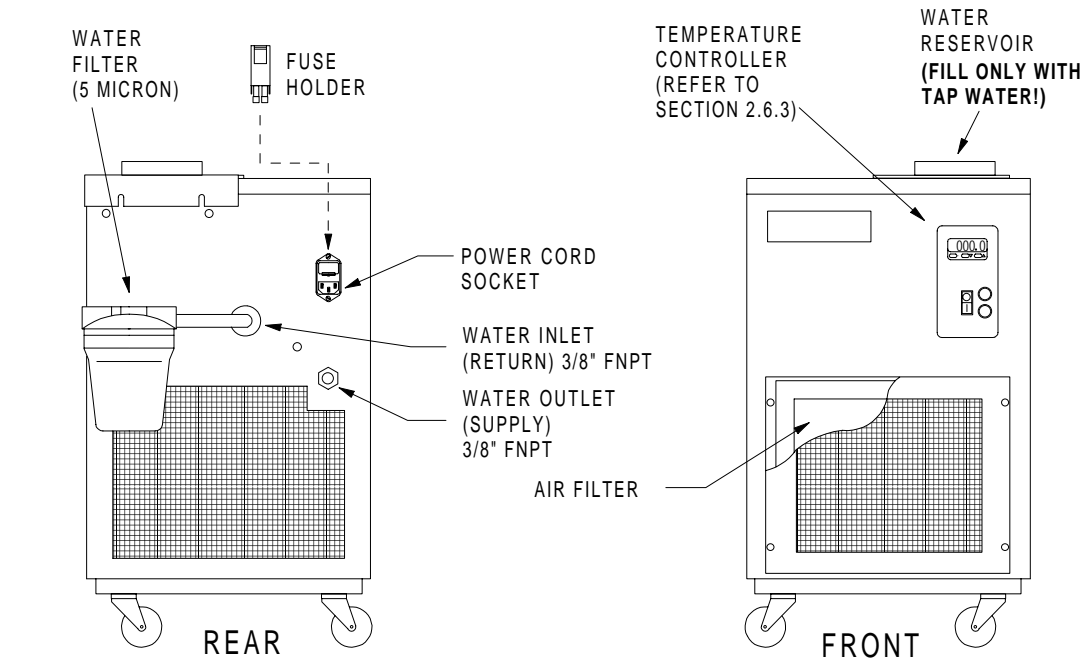


Figure 3 - Optional Water Chiller and Service Connections

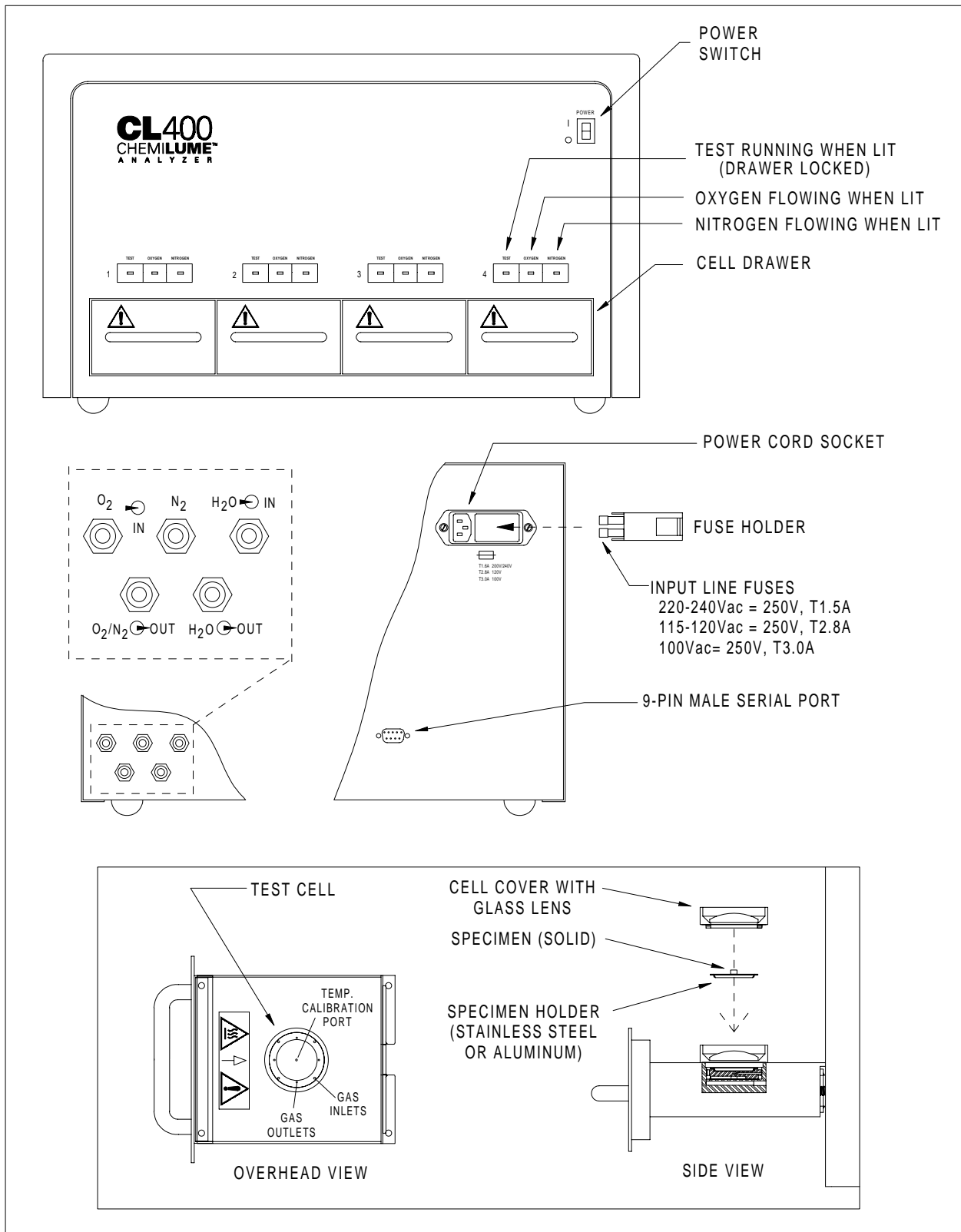


Figure 4 - CL400 ChemiLume Component Descriptions

2.5 SYSTEM CONNECTIONS (cont.)

2.5.3 Chiller Leak Check

1) Grasp the lower portion of the filter housing on the water chiller (Fig. 3) and unscrew it by turning it counter-clockwise. If the filter is not present, place it into the lower housing. Make sure the large O-ring is present on the housing. Firmly screw the housing back into place.

2) Fill the chiller with tap water (Fig. 3).

3) Plug the power cord into the chiller and into an appropriate AC power outlet.

4) Start the chiller by setting its power switch to On (I). The water pump runs continuously.

5) Check the water level in the reservoir and add more water until the chiller runs continuously.

6) With the chiller operating, examine all connections for leaks. Tighten or adjust those that are leaking.

7) Adjust the chiller temperature setpoint as follows: Press and hold the Set key (at far left marked *) and press the up (^) or down (v) arrow key until the setpoint is 18°C (65°F). Release the Set key. Shut off the chiller. Additional instructions for fine tuning this setting are included in Section 2.6 System Startup.

2.5.4 Electrical Connections - Power

Electrical power is supplied to the CL400 and the water chiller by standard plug-in power cords (Figs. 3 and 4). Plug the respective cords into the equipment and an appropriately configured AC power outlet.

- The components of this system include devices for extra protection from electrical shock. The protective devices may not function properly unless the power cords are connected to properly grounded outlets.

- It is the user's responsibility to ensure that a proper ground connection is provided.

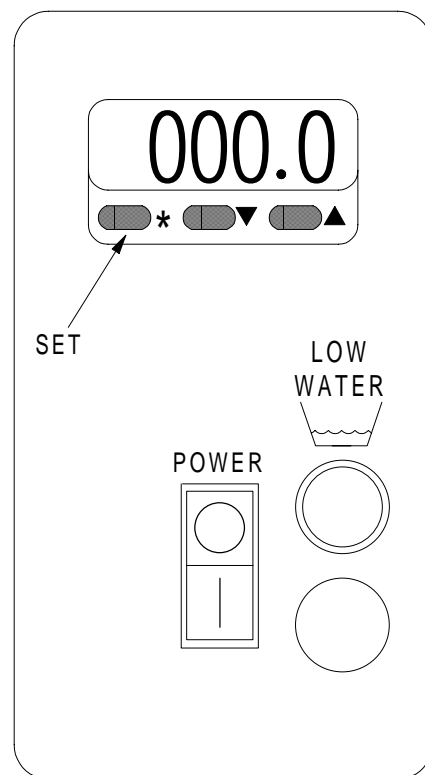


Figure 5
Chiller Temp. Controller

2.5 SYSTEM CONNECTIONS (cont.)

2.5.5 Computer Connections

Locate the computer next to the CL400 on the bench. Plug the monitor signal cable connector into the monitor port at the rear of the computer (Fig 6). Plug the keyboard cable connector into the keyboard port on the back of the computer. Plug the mouse connector into the mouse port at the rear of the computer.

CAUTION! Before installing the computer power cord, set the voltage selector beneath the power cord socket to match your supply voltage. Use a ball-point pen or pointed tool to slide the selector to the proper position (230V position shown).

Connect the power cords to the monitor and the computer and into an appropriately configured AC power outlet.

Connect the 9-pin serial communications cable to the port on the back of the CL400 (Fig. 3) and to the serial port on the back of the computer. If you are connecting more than one CL400 to the computer, please refer to the note under Computer Requirements in Section 2.4 System Requirements.

Continue with the procedures in Section 2.6 System Startup to verify operation of the CL400 and computer.

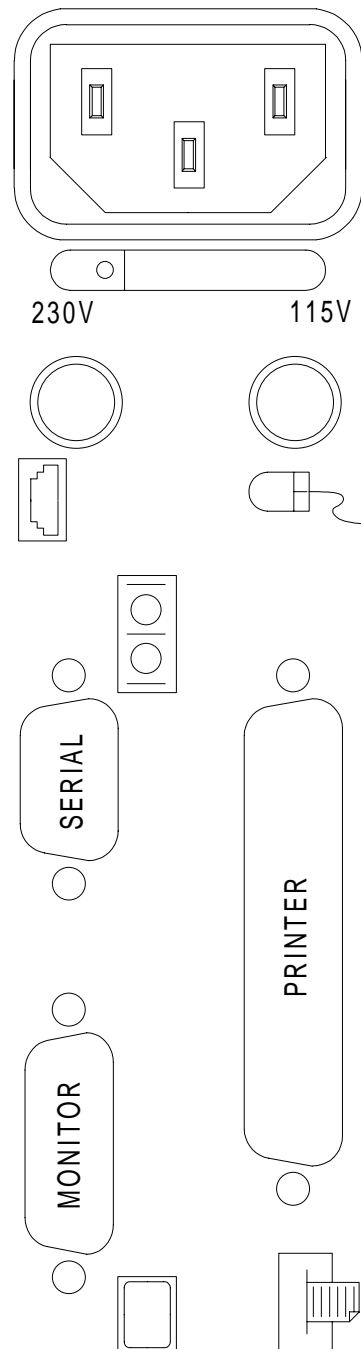


Figure 6
Computer Ports

2.6 SYSTEM STARTUP

Initially you must verify that the computer is functioning properly, that the CL400 powers up and that the chiller temperature is properly set. Full functionality of the CL400 cannot be verified until the software program is operating and initial calibrations are performed.

2.6.1 CL400 ChemiLume

1) Turn on the CL400 power switch (Fig. 4). The power switch should light up to indicate power is present. If it doesn't, check the power cord connection to ensure it is fully engaged in the socket on the back of the unit and plugged into an AC power outlet of the correct voltage.

2) If the power switch is still not lit, unplug the CL400 from the power source and check the input fuses on the back of the unit (Fig. 4). Contact Atlas Service if the CL400 fails to operate when power is applied.

3) Turn on the chiller.

2.6.2 Computer and Monitor

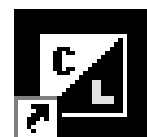
Important: To conduct the following steps the CL400 software program must be installed. **Refer to software installation instructions (with disks) if the program is not present on your computer.**

1) Turn on the video monitor.

2) Make sure that the computer disk drive is empty. Remove any disk or shipping protector from the drive.

3) Turn on the computer power switch. The Windows 95 operating system will initiate.

4) The Windows 95 initial screen (desktop screen) includes a CL400 ChemiLume icon (Fig. 7). Move the mouse cursor onto the icon and double click the left mouse button to start the CL400 program. If the program gives an error message about the COM port connection, make sure you have properly installed the serial cable between the computer serial port and the CL400 serial port.



CL400

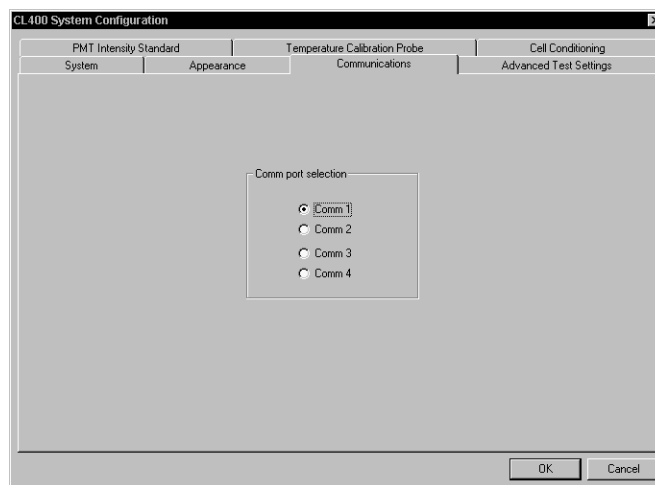
Figure 7
Program
Icon

2.6 SYSTEM STARTUP (cont.)

5) If an error message is still present, click on the **system** button at the top of the screen and select the Communications menu (Screen 2-1).

6) Click on the appropriate Comm (communications) port button that matches the port to which you connected the CL400 serial cable at the back of the computer.

7) Click on the Control menu at the top of the screen and select Initialize ChemiLume. The controller initialization screen will appear momentarily, indicating that communications have been properly established between the computer and the CL400.



Screen 2-1 Communications Menu

2.6.3 Chiller Temperature Adjustment/Tuning

It is of key importance that the chiller setpoint is adjusted to a value 3° to 5° above the dew point (the temperature at which condensation will occur). Setting it too low may cause water condensation on the PMT light sensing tubes inside the CL400. This can have an adverse effect upon light sensing accuracy and stability. This is of greatest concern in laboratories with high humidity levels, especially during the summer months. The chiller setpoint should be adjusted to a value within the range of 16°C (60°F) to 21°C (70°F). Adjust it to an upper value of this range if condensation is noticed on the water lines or metal connection hardware.

Adjustment of the chiller temperature is a two-step process. As described previously, the temperature setpoint is adjusted by holding the Set key and then pressing the up or down arrow key until the desired setpoint is indicated. For the most precise temperature regulation, the controller may additionally be tuned by conducting the procedure below. Factory testing has proven that tuning of the chiller controller at 18°C (65°F) with no load (CL400 heaters off) provides adequate temperature control at elevated test temperatures.

This section describes initial settings that must be performed in the CL400 ChemiLume software before tests may be conducted. These include inputting of:

System Description (I.D. & configuration file name)

PMT Intensity Standard specifications

Temperature Calibration Probe specifications

Advanced Test Settings (PMT gain & filter values)

Cell Conditioning Settings (Threshold & duration)

Appearance Settings (color & graphing preferences)

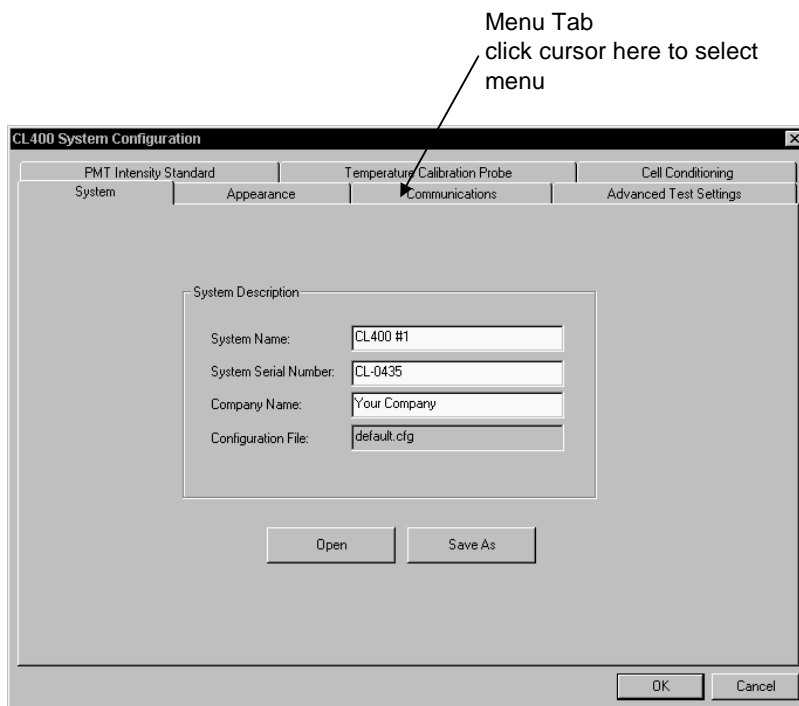
These settings are used by the program for test report header construction, calibration procedures, operating tolerances and scaling of readings. **Refer to instructions provided with disks to install or upgrade the software program.**

3.1 SYSTEM DATA

1) Start the system computer as described in Section 2.6.2. Start the CL400 ChemiLume program by double clicking on the program icon.

2) Click on the **system** button at the top of the screen or click on the File menu at the upper left and select System Configuration.

3) Click on the System menu tab to bring up the System Description parameters as shown in Screen 3-1.



Screen 3-1 System Configuration Menu

4) **System Name:** Click in the white edit box and type in the name you prefer for the CL400. If you have more than one CL400 attached to the computer it is advisable to include an identifying number in the name.

5) **System Serial Number:** Type in the serial number found on the label at the back of the CL400.

3.1 SYSTEM DATA (cont.)

6) **Company Name:** Type in the name of your company. This name appears on the test report.

7) **Configuration File:** Indicates the currently loaded configuration (.cfg) file that defines the software setup.

Note: If the configuration file name “default.cfg” is used, this file will be loaded automatically at program startup. If you wish to create different configuration files to be used with different CL400 units, return to this screen (System) after you have performed the setup in Sections 3.2 through 3.6. Be aware that this file will contain the specifications for your calibration standards and PMT gain settings, etc. Thus, you must be careful that these are properly configured for each new configuration file created. At program startup you may load a uniquely named configuration file by accessing this screen and clicking on the Open button. These procedures are discussed in detail in Section 3.7.

8) **Do not** click the OK button in these procedures until you are advised to do so.

Important: When you finally exit from the system configuration menus (by clicking on the OK button), all settings will be automatically saved in the file designated in Step 7 above. Or you may save the configuration under a new file name (see Section 3.7).

3.2 PMT INTENSITY STANDARD

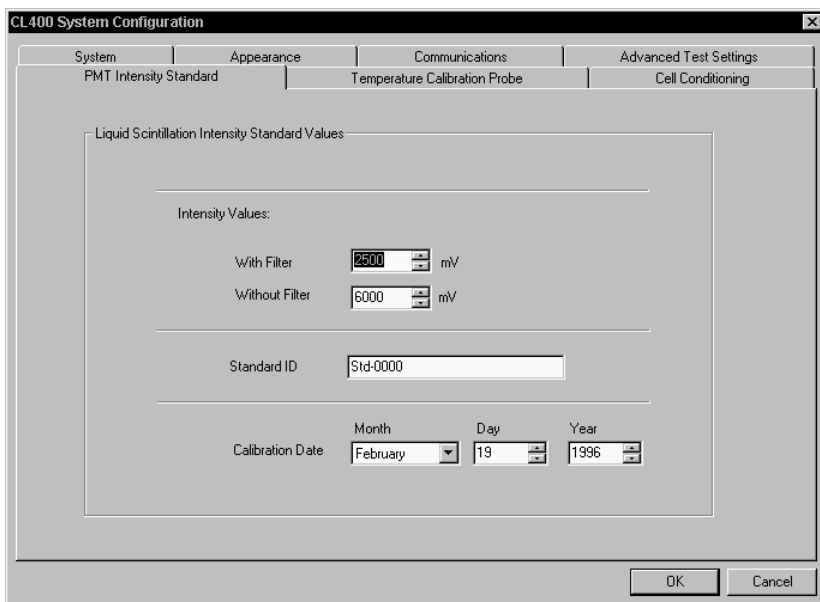
An optional kit is available for use with the CL400 that contains a liquid intensity standard. The standard is a radioactive, low-emission source. It is used to calibrate the PMT (photomultiplier tube) or light sensor monitoring each test cell. The intensity standard comes with a specification sheet that characterizes its emission (output) and the date these measurements were performed. This is critical information that must be recorded in the software configuration to allow accurate PMT calibration.

1) Click on the PMT Intensity Standard menu tab to bring up the Standard Values listing (Screen 3-2).

3.2 PMT INTENSITY STANDARD (cont.)

2) Refer to the specification sheet provided with your intensity standard. Click in an edit box and type in the appropriate value for each parameter specified in the menu. You may also click on the arrow buttons to increment the value in an edit box.

Important: Do not leave any parameters blank, each is required for proper operation. Be sure to fill in the month, day and year. These are critical for accurate determination of the intensity standard's output over time since it declines (decays) at a very specific rate.

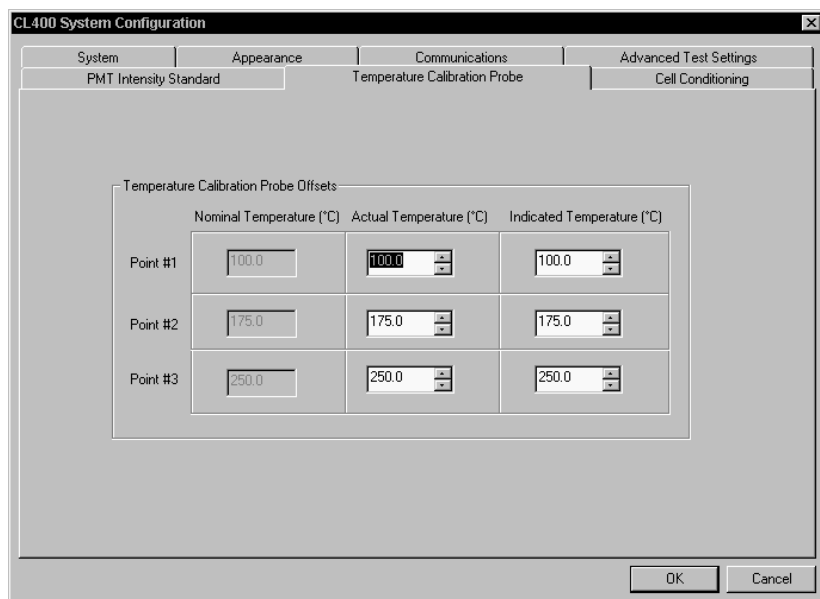


Screen 3-2 PMT Intensity Standard Configuration Menu

3.3 TEMPERATURE CALIBRATION PROBE

The optional temperature calibration kit includes a probe and meter that are used to calibrate the cell temperature control system. This menu (Screen 3-3) includes Actual and Indicated Temperature values that allow the software program to determine the offset between system and meter probe readings. These values are included on the certificate supplied with the temperature probe and must be entered in this menu.

1) Click on the Temperature Calibration Probe menu tab to bring up the menu.



Screen 3-3 Temperature Calibration Probe Configuration Menu

3.3 TEMP. CALIBRATION PROBE (cont.)

2) Click in the white edit boxes and type in the required parameters for the Actual and Indicated Temperatures as listed on the calibration probe certificate.

3.4 ADVANCED TEST SETTINGS

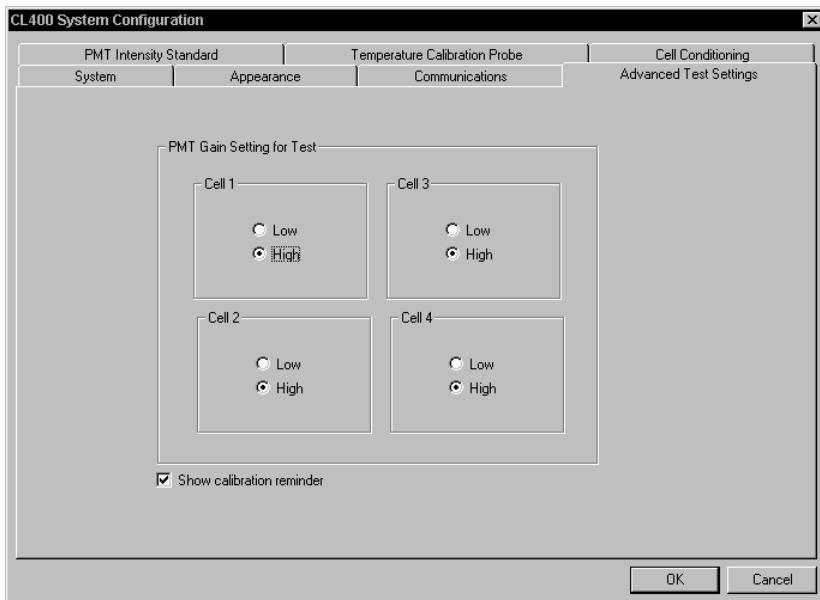
These settings allow the user to select the sensitivity level of the PMT (photomultiplier tube or light sensor) for differing specimen emission rates. An automatic calibration reminder, that will appear on the screen before each test is initiated, may also be enabled in this menu

1) Click on the Advanced Test Settings menu tab (Screen 3-4) to bring up the menu.

2) Click in the white box beside **Show calibration reminder** until an X appears if you would like the software program to provide an on-screen reminder about performing required calibrations. These include the PMT{ XE "PMT" } and temperature calibrations. It is recommended that the PMT calibration be performed daily to ensure accurate PMT intensity readings. The temperature calibration is normally performed every 6 months. The on-screen reminder ensures that the operator is aware of these requirements at appropriate times.

Note for Initial Software Configuration

Skip the steps below if you are performing the software configuration for the first time. The following procedures are normally performed during test setup after you are aware of the test conditions required in each test cell. The test setup procedure will refer you back to this section.



Screen 3-4 Advanced Test Settings Configuration Menu

3.4 ADVANCED TEST SETTINGS (cont.)

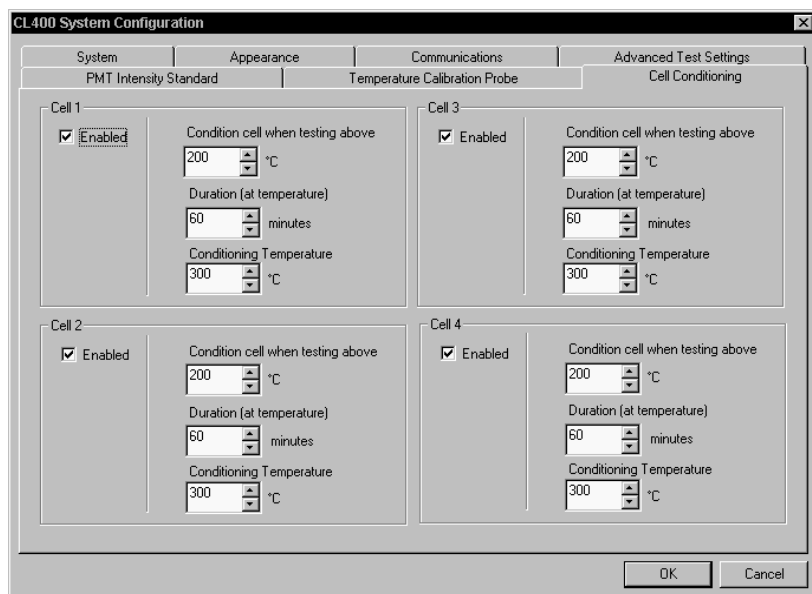
Procedures for Test Setup

1) Select a **PMT Gain Setting** for each test cell by clicking in the white dot to the left of the desired setting. The normal gain selection is High. Use Low gain only for materials known to exhibit high light emissions while oxidizing. This setting prevents saturation of the PMT, which results in test stoppage.

Note: For specimens with unknown light emission levels you must perform an initial test with the PMT Gain set to Low. If Intensity readings are too low or unstable, perform a second test using the High gain setting.

3.5 CELL CONDITIONING SETTINGS

Cell conditioning is performed at the beginning of each test, before specimens are placed in the holders, to clean the specimen holders of any contaminants that could emit light and alter test results. The empty holders are heated at an elevated temperature (at least 50°C above the peak test temperature) for a duration of at least 60 minutes. This applies to tests that have a peak temperature of at least 200°C. For tests at lower peak temperatures, non-residual solvent (such as freon) cleaning of the specimen holders and cell lens cover is acceptable.



Screen 3-5 Cell Conditioning Phase Settings

Note for Initial Software Configuration

Skip the steps below if you are performing the software configuration for the first time. The following procedures are normally performed during test setup after you are aware of the test conditions required in each test cell. The test setup procedure will refer you back to this section.

3.5 CELL CONDITIONING SETTINGS (cont.)

CAUTION: Even with new specimen holders, the only effective method for removing microscopic contaminants is by heating to elevated temperature. DO NOT attempt to disable Cell Conditioning and resort to solvent cleaning methods for tests with peak temperatures above 200°C, or test results will be unreliable and unrepeatable.

Procedures for Test Setup

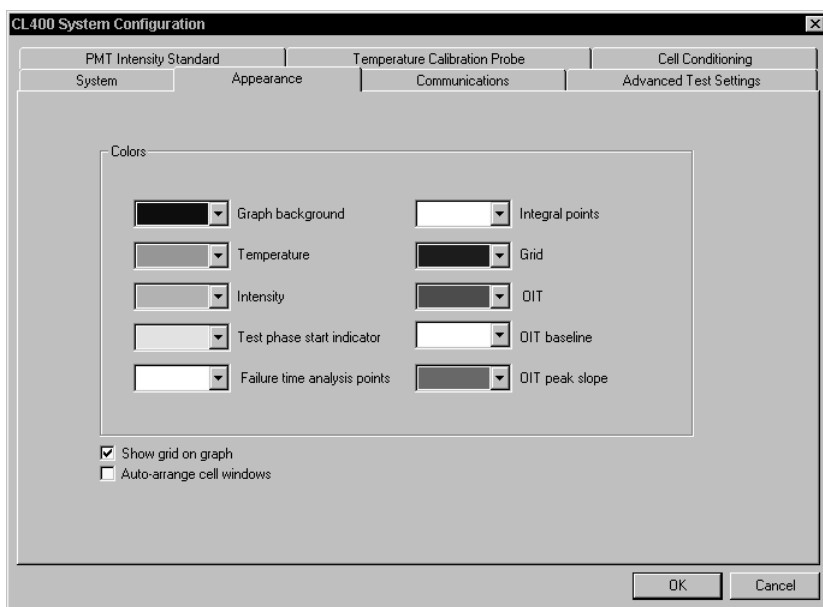
- 1) Enable cell conditioning by clicking in the white box beside “Enable” until a check mark appears. Cell conditioning is required for tests that have a peak temperature of 200°C or higher.
- 2) Click the cursor in the white edit box beneath **Condition cell when testing above**. Type in a value or increment it with the indexer arrows. This should be set to the test temperature above which you wish cell conditioning to always take place. The factory default is 200°C (since solvent cleaning of the specimen holders is adequate for peak test temperatures up to this value). It may be set lower than 200°C if desired.
- 3) Set a Cell Conditioning Phase **Duration** for each test cell. The normal setting is 60 minutes. Click the mouse pointer in the edit box and type in a value or increment the reading by clicking on an indexer arrow button.
- 4) Set a **Conditioning Temperature** for each cell. This is the temperature to which the empty holder will be heated to clean it before the specimen is loaded. It is standard practice to set the conditioning temperature for a cell to a value that is 50°C above the peak test temperature to be reached in that cell. Set each by clicking in the white edit box and typing in a value or by incrementing the value by clicking on an indexer arrow. The maximum allowable setting is 300°C.

3.6 APPEARANCE SETTINGS

This menu allows selection of screen colors for graphs and analysis data, as well as selections for the use of a graph grid overlay and cell window arrangement. Graphs appear in the All Cells window and in the Analyze window for each cell if a test is running (or if an archived file is open).

1) Click on the Appearance menu tab (Screen 3-6) to bring up the menu.

2) Choose screen colors for the various graph elements by clicking on the pull-down menu button (down arrow) and then the desired color.



Screen 3-6 Appearance Settings Configuration Menu

Graph Background:	fill color of graph, normally black or white for best contrast
Temperature:	cell temperature curve
Intensity:	light intensity curve
Test Phase Start Indicator:	vertical line on graph indicating start of test (oxygen flow) phase
Time to Failure Points:	user-adjustable endpoint lines that define analysis limits
Integral Points:	user-adjustable endpoint lines that define analysis limits
Grid:	graduated grid overlay on graph
OIT:	line indicating Oxidation Induction Time (result) on graph
OIT Baseline:	user-adjustable baseline indicator line for OIT analysis
OIT Peak Slope:	user-adjustable slope indicator line for OIT analysis

3.6 APPEARANCE SETTINGS (cont.)

3) Click in the white box beside **Show grid on graph** until a check mark appears if you want a grid overlaying the graphs for easier reading.

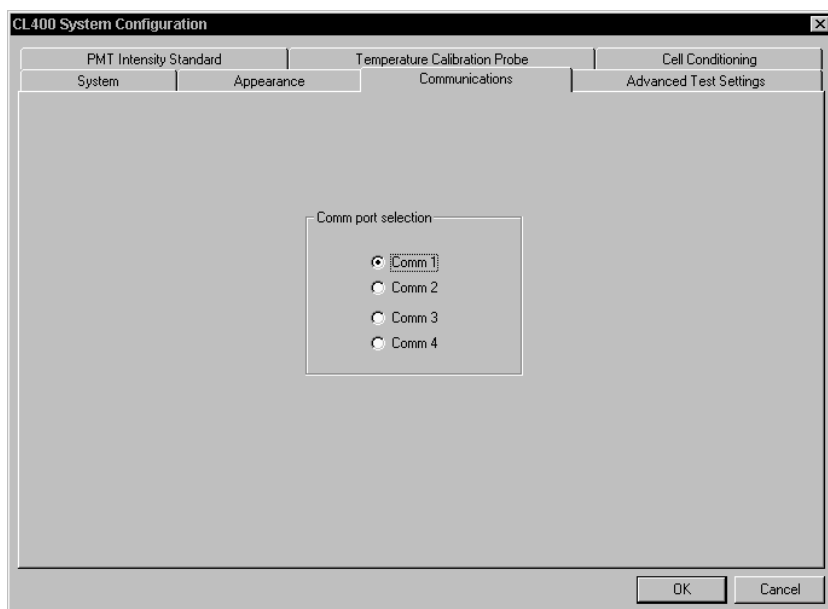
4) Click in the white box beside **Auto-arrange cell windows** until a check mark appears if you prefer to have only one program window open at a time and auto-minimizing of all others that are open.

3.7 COMMUNICATIONS SETTINGS

This menu allows selection of the serial communications (COM) port that the software uses to communicate with the CL400.

1) Click once on the Communications menu tab (Screen 3-7) to bring up the menu.

2) Click in the white circle beside the Com port designation to select the computer serial port to which the CL400 is connected. A black dot appears in the white circle to mark the selection.



Screen 3-7 Communications Configuration Menu

3.8 SAVING THE CONFIGURATION FILE

The new software configuration can be saved in two ways: 1) by clicking on the OK button at the lower right of the menu - all settings are saved in the current configuration (.cfg) file; or 2) by returning to the System menu and clicking on the Save As button - the configuration file may be given a new name (ending in .cfg).

The main purpose of the Save As button is to allow the user to create new configuration files without altering the startup settings initially saved in the DEFAULT.CFG file, normally loaded at startup.

3.8 SAVING THE CONFIGURATION FILE (cont.)

Preserving the DEFAULT.CFG file and performing a Save As to create new configuration files will allow the user to always be aware of the startup settings when creating a new file. Atlas advises saving the initial configuration to the DEFAULT.CFG file, and then creating user configuration files from it with the Save As function.

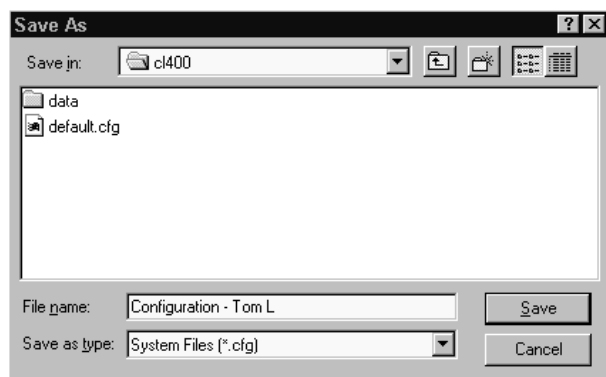
Saving the DEFAULT.CFG File

Save the initial software configuration just completed as **default.cfg**. Create customized configuration files for multiple CL400 units by following the steps under **Saving Customized Configuration Files** below.

- 1) Click on the System menu tab to bring up the System menu (Screen 3-1).
- 2) Click on the OK button at the lower right of the window and the file will be saved to the hard disk. The System Configuration menu will close.

Saving Customized Configuration Files

- 1) Click on the **system** button at the top of the screen or click on the File menu at the upper left and select System Configuration.
- 2) Perform the procedures detailed in Sections 3.1 through 3.7 applicable to the configuration options you wish to customize.
- 3) Click on the System menu tab to bring up the System menu (Screen 3-1).
- 4) Click on the Save As button and the Save As dialog box (Screen 3-8) will appear.
- 5) Type in the desired file name (ending with .cfg) and then click on the Save button.
- 6) The file just saved will become the currently loaded configuration file. To create additional new configuration files, open the DEFAULT.CFG file in the System menu, make alterations and then perform a Save As.

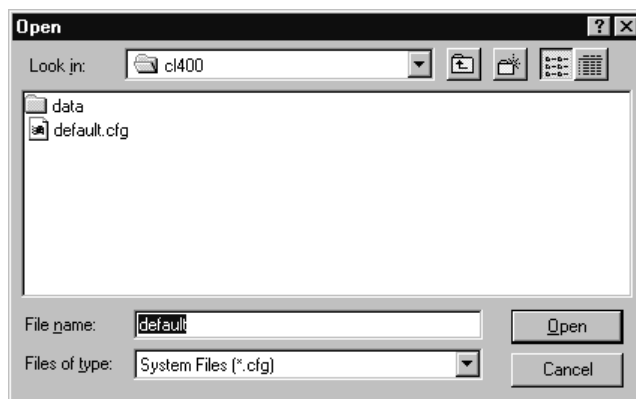


Screen 3-8 System Save As Dialog Box

3.9 OPENING A CONFIGURATION FILE

When the CL400 software program is started, it automatically loads the DEFAULT.CFG file and is configured with the settings of that file. If you wish to load a different configuration file, in which you have saved custom settings for graph colors, advanced test settings, etc. as described in Sections 3.1 through 3.6, you must load it from the System menu. Proceed as follows:

- 1) Click on the **system** button at the top of the screen or click on the File menu at the upper left and select System Configuration.
- 2) Click on the System menu tab to bring up the System menu (Screen 3-1).
- 3) Click on the Open button and the Open File dialog box (Screen 3-9) will appear.
- 4) Double click on the file you wish to load, or click in the edit box beside "File name:", type in the file name and click on Open.
- 5) The default.cfg file will be closed and the new file will be opened, with its settings now defining the software configuration.
- 6) Continue with your testing or analysis procedures.



Screen 3-9 System Open File Dialog Box

3.10 AUTOLOADING A CONFIGURATION FILE

The CL400 program icon can be set up to automatically load a specific configuration file (rather than default.cfg) whenever the icon is used to start the program. Follow the procedure below if you want to enable this feature.

- 1) Start the system computer.
- 2) Move the mouse cursor onto the CL400 ChemiLume program icon. Press the right mouse button and the icon menu (Screen 3-10) will appear.

3.10 AUTOLOADING A CONFIG. FILE (cont.)

3) Select Properties from the menu and the Properties menu (Screen 3-11) will appear.

4) Select the Shortcut menu by clicking on the Shortcut menu tab. Click in the edit box beside "Target:" and add the following text (shown in bold face) to the right of the program path and file name:

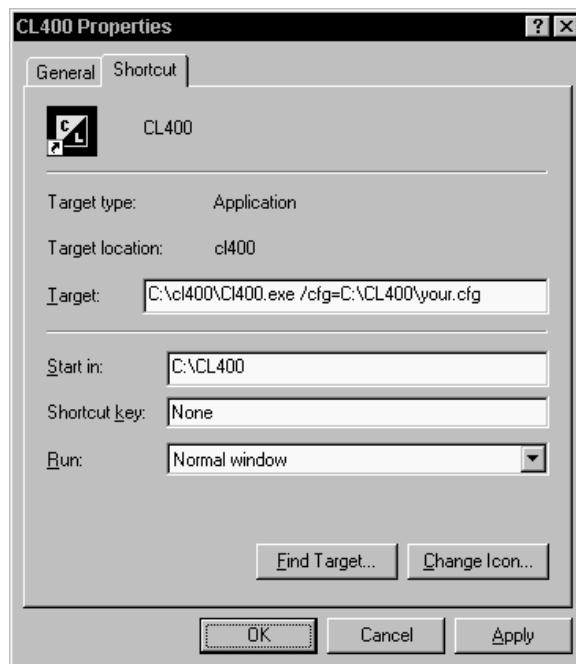
C:\CL400\CL400.exe /cfg=c:\CL400\your.cfg

where:

/cfg= indicates that a unique configuration file is to be loaded

C:\CL400\ indicates the path to the subdirectory in which the .cfg file is located

your.cfg is the name of the configuration file to load at program startup



Screen 3-11 Shortcut Editing Menu

Note: If your configuration file is located in a subdirectory other than C:\CL400, change the path in the command line to reflect the actual subdirectory location.

5) Click on the OK button when finished.

6) Repeat the procedure above for each CL400 icon on the desktop (applicable only to multiple instrument installations).

7) Confirm that you have performed the above steps properly by double clicking on the CL400 program icon to start the program.

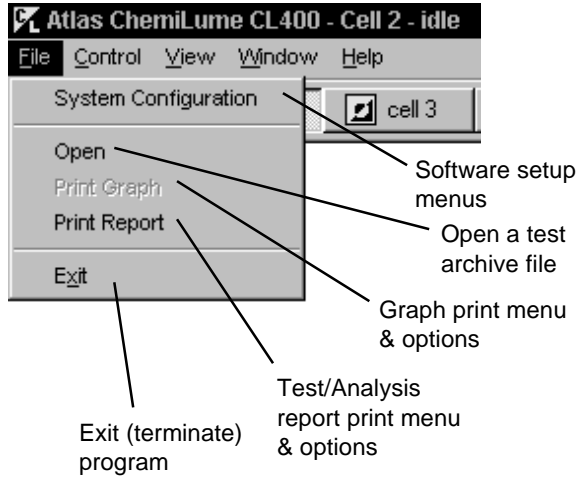
8) In the program, click on the System button near the top of the screen and then click on the System menu tab. The System menu should indicate the file you designated for autoloading beside "Configuration File:". If the file name shown is "default.cfg", repeat the steps above and check the command line in the "Target:" edit box (Screen 3-10) for typing errors.



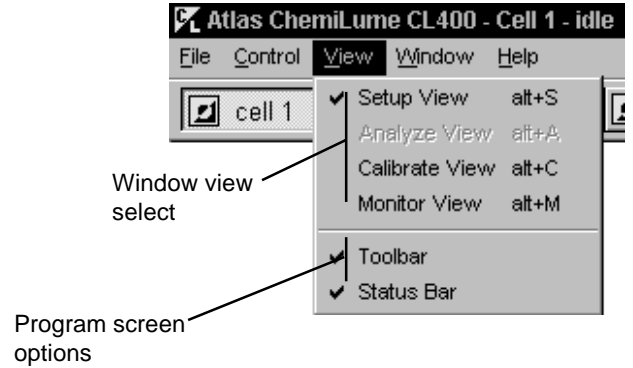
Screen 3-10
Program Icon Menu

4.1 MENU COMMANDS

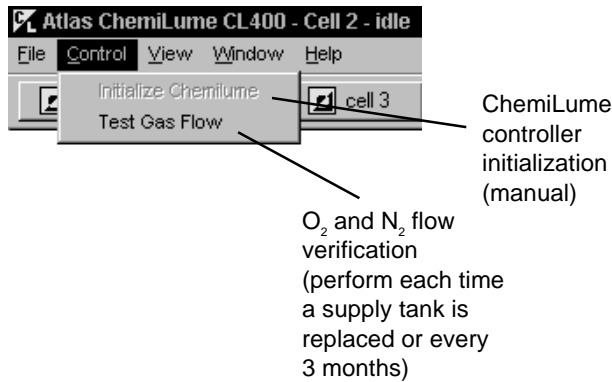
File



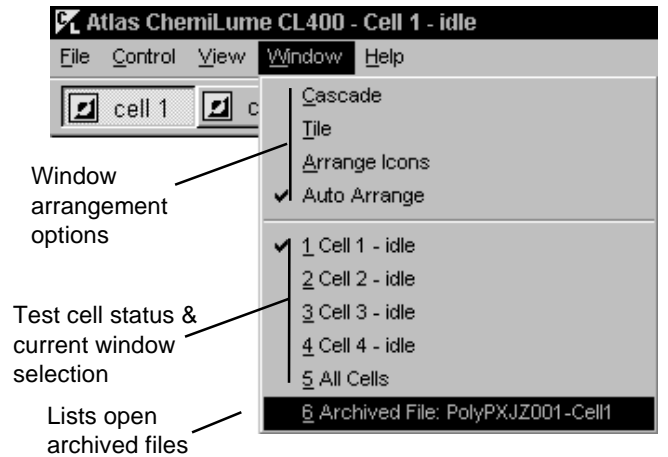
View



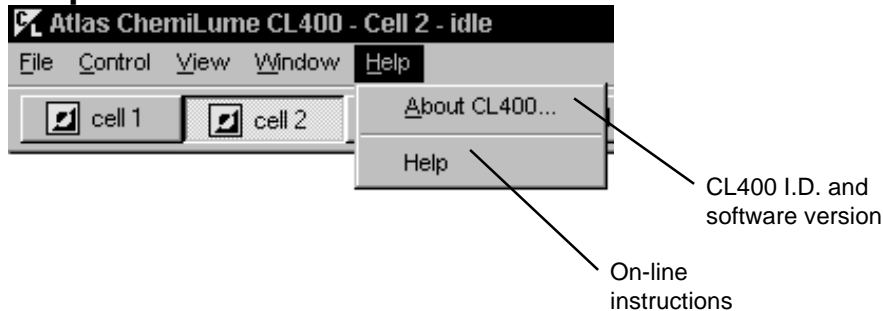
Control



Window



Help



4.2 SCREEN CONTROLS

The screenshot shows the Atlas ChemiLume CL400 software interface. The main window is titled "Cell 1 - testing Polypropylene XJZ-001". It features a menu bar (File, Control, View, Window, Help) and a toolbar with icons for cell selection, system, graph, report, open, and help. The main display area is divided into several sections:

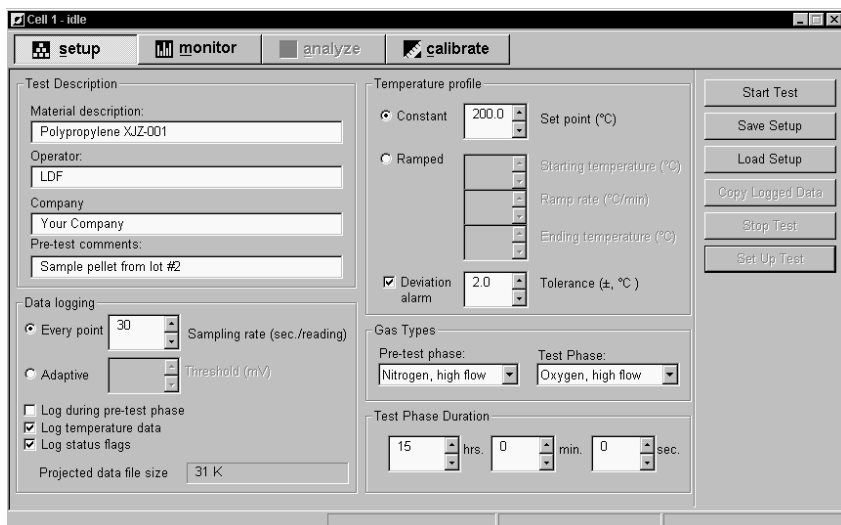
- Test State:** Includes fields for Temperature (Pre-test stabilization in progress), Gas flow (Nitrogen flow detected in system), Gas type (Nitrogen, high flow rate), PMT coolant (OK), and Door (Closed, locked).
- Temperature:** A vertical scale from 0.0°C to 300.0°C, currently showing 44.6°C.
- Intensity:** A vertical scale from 0mV to 10000mV, currently showing 0mV.
- Test Progress:** Shows pre-test start time (5/7/1997, 2:56:56PM) and test start time (Still in pre-test phase). An elapsed time counter shows 00 hours, 00 minutes, and 32 seconds.
- Buttons:** Stop Test, Open Door, Start Test, Copy Logged Data, Save Setup, Load Setup, Clear Warnings, and Set Up Test.
- Logging File:** ppxjz1.bt

At the bottom, there is a status bar with "Factory defaults", "Comm 1,OK", and cell status indicators for CELL 1, CELL 2, CELL 3, and CELL 4. The time is 2:57 PM.

Labels pointing to various controls include:

- Menu select
- Cell window select buttons
- Close window (double click)
- View select buttons (4)
- System configuration menus
- Graph print menu & options
- Report print menu & options
- Open test archive
- On-line instructions
- Restore program window
- Minimize program
- Exit program
- Current window
- One or more additional open windows
- Minimized cell window (double click to maximize)
- Communications (COM) port status
- Cell status indicators
- Gray = cell idle
- Green = normal (test running)
- Yellow = warning (latching)
- Red = fatal error (test stop)
- Blue = calibration in progress
- Purple = cooling down
- White = cell conditioning in progress
- Instrument Indicator

4.3 WINDOW VIEWS



test SETUP view

This view is used to define test conditions and initiate a test.

Parameters

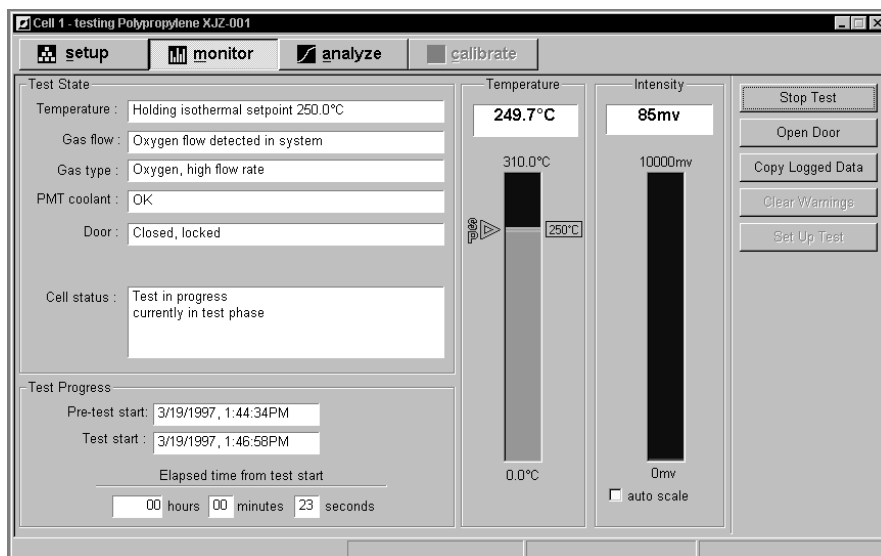
- Test and Specimen Description
- Data Logging Options
- Temperature Profile
- Gas Selection and Flow Rate
- Test Duration
- Test Setup Save and Load
- Test Start, Stop & Setup

MONITOR view

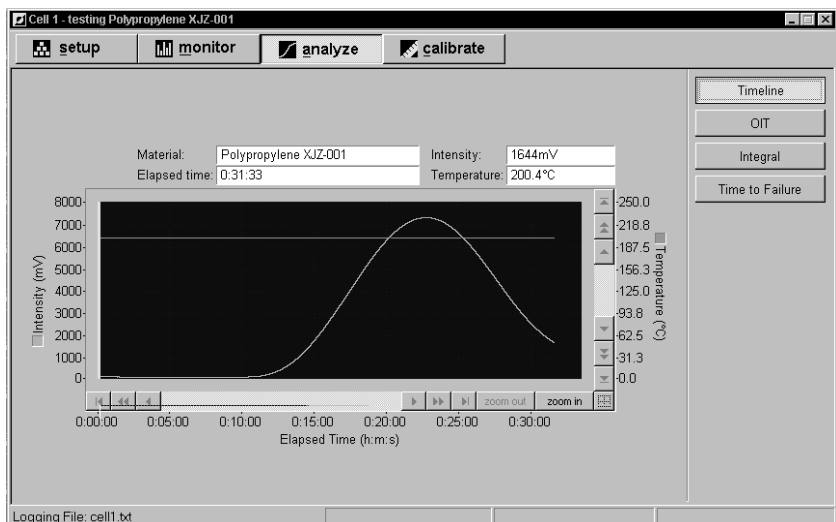
This view displays test progress in text and graphical formats.

Parameters

- Instrument Status
- Event Progress (elapsed time)
- Temperature Bar Graph
- Temperature Setpoint
- Intensity Bar Graph
- Stop Test, Copy Logged Data, Clear Warnings, Start New Test



4.3 WINDOW VIEWS (cont.)



test data ANALYZE

This view provides real-time graphing of test data and tools for performing three data analyses.

Functions

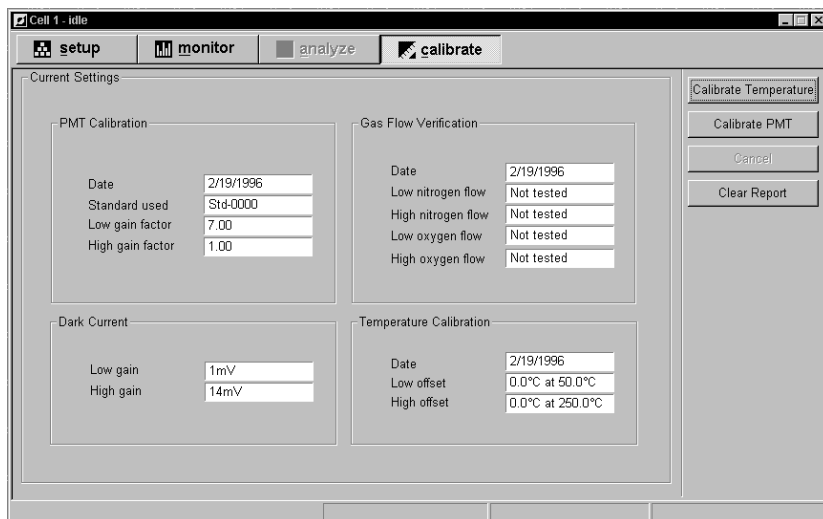
- Graph Zoom & Pan
- Oxidation Induction Time Analysis
- Integration of Intensity Curve
- Time to Failure Analysis
- Activation Energy Determination
- Auto/User-Selectable Analysis Limits

instrument CALIBRATE

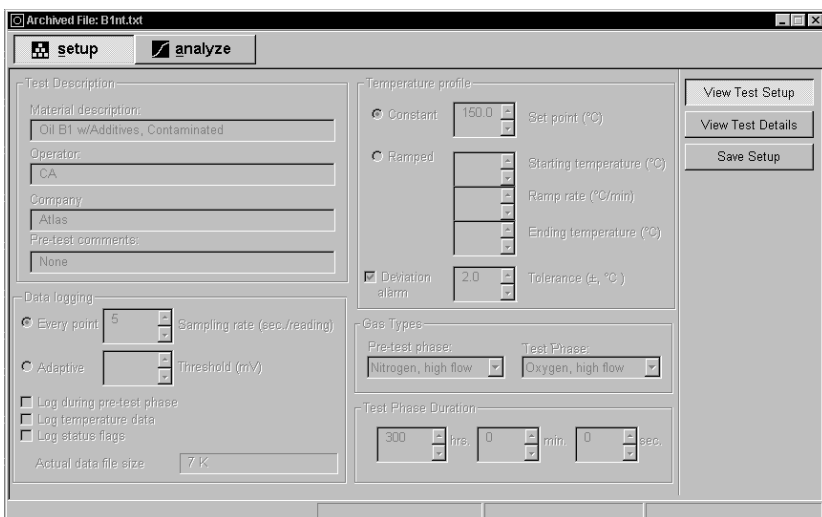
This view is used to perform the cell temperature calibration & the PMT (light sensor) calibration, as well as to view and print a summary of calibration related settings.

Parameters

- Calibrations History
- Procedural Prompts for Operator
- Dark Current Values Display
- Printable Calibration Reports
- Accept/Discard New Values
- View/Print Cal. Setting Summary



4.3 WINDOW VIEWS (cont.)



archive file SETUP View Setup

This view shows the test setup of an archived data file. The setup may be saved under a new name, but cannot be edited in this view.

Functions

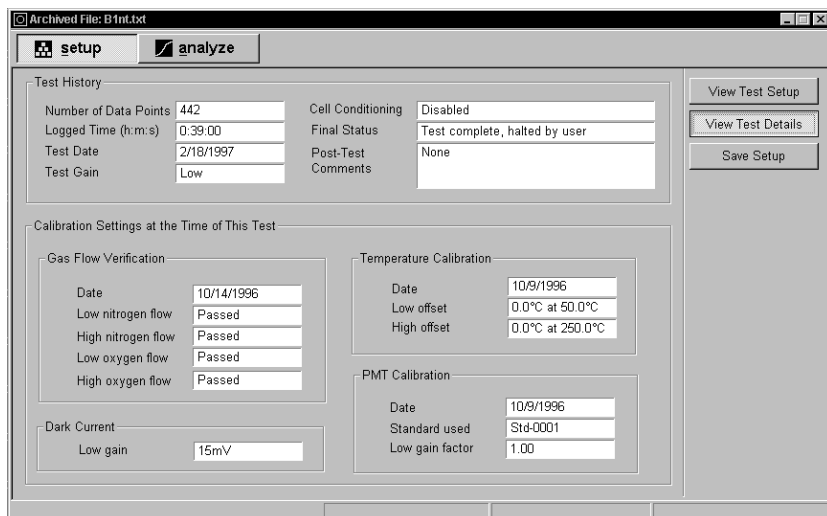
- Test Setup of Data File
- View or Save Setup (to new name)
- View Test Details

archive file SETUP View Test Details

This view shows the historic information of an archived data file.

Parameters

- Data Points Collected
- Elapsed Time of Logging File
- Date Test Performed
- Final Test Status
- Original Post-test Comments

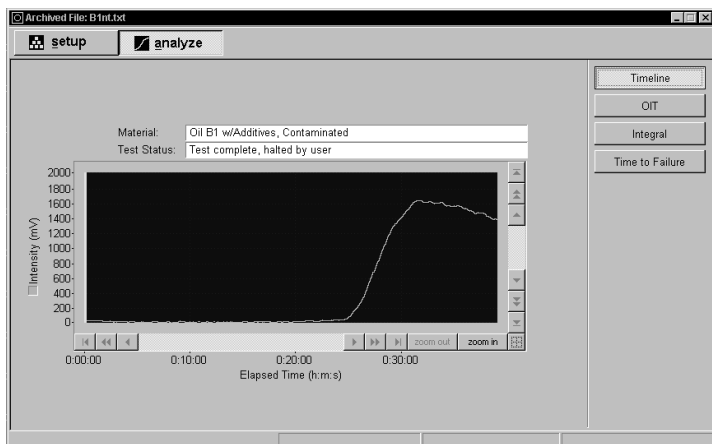


archive file ANALYZE Timeline View

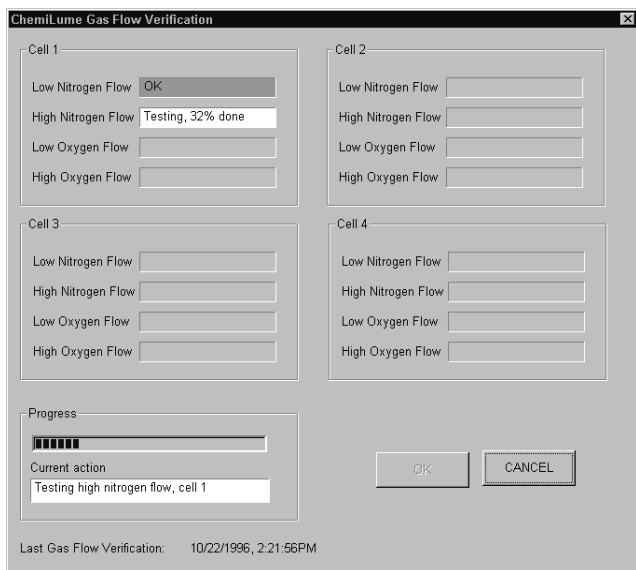
This view allows archived test data files to be analyzed. Four different analyses may be performed.

Functions

- Timeline View of Test Data
- Oxidation Induction Time Analysis
- Intensity Curve Integration Analysis
- Time to Failure Analysis
- Activation Energy Analysis



4.4 SPECIAL MENUS



Gas Flow Verification

This screen is used to confirm gas flow and gas sensor operation (see Section 6.3). It checks the four gas flow rates for each cell.

Functions

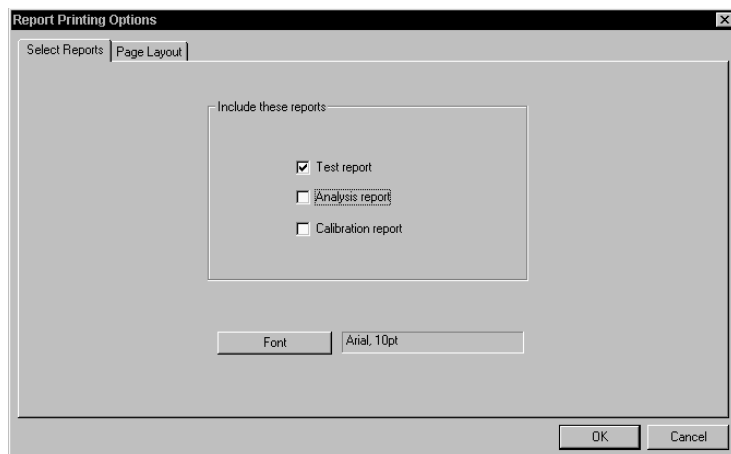
- O₂ and N₂ Supply Check
- Low and High Flow Rate Check
- Progress Indicator
- Pass/Fail Notification

Print Options - Report

Choices for report types to be printed are made in this screen. Font face and size may be specified in Page Layout.

Reports

- Test (test results)
- Analysis (4 types)
- Calibration (PMT or temp.)

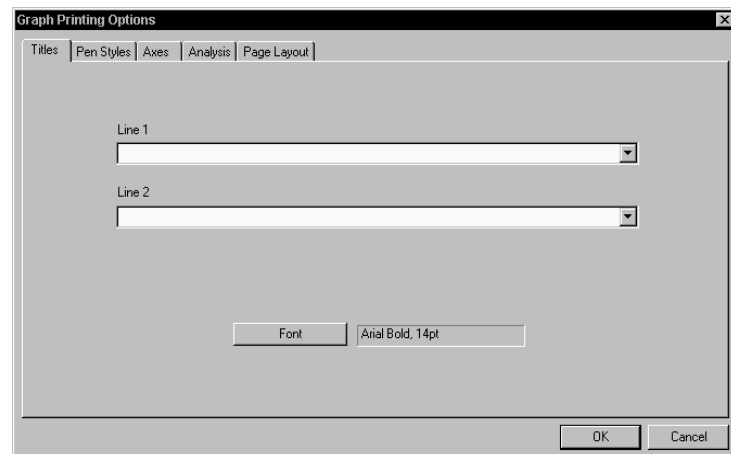


Print Options - Graph

User preferences for printing graphs of analysis results are specified in these screens.

Parameters

- Titles & Axes
- Pen (line) Colors
- Page Layout & Fonts
- Analysis



5.2 PMT CALIBRATION

Perform the PMT calibration (Section 6.1) at the beginning of each testing day. Print the summary of results each day and compare them to determine calibration stability. If conditions in your laboratory are very stable, the PMT calibration interval may be lengthened to twice, or even once per week.

5.3 TEST DEFINITION

To run a test in the CL400, you must first specify the temperature profile, data logging interval, gas type and I.D. information for the test report. The Setup view of each cell window is used for this purpose. The independent Setup views allow you to perform up to four different tests at the same time, or the same test on four different specimens. As well, you may conduct identical tests with identical specimens in each cell for rapid determination of a material's average performance. You may setup and initiate a test in one or more cells while tests are still running in other cells.

5.3.1 Cell Conditioning Phase

Tests having a peak temperature of 200°C or above include a cell conditioning phase during which a new, empty specimen holder in each cell is typically heated to the peak test temperature plus 50°C (see Section 3.5 for instructions on setting the cell conditioning temperature). This high temperature exposure will eliminate any contaminants that could emit light during the test and alter results. After this, the specimens are carefully loaded and the test initiated.

Note: For tests with peak temperatures below 200°C, cell conditioning may be disabled and the specimen holders solvent cleaned with a non-residual solvent (such as freon). Refer to Section 3.5.

5.3.2 Procedure

- 1) In the software program, bring up the window for a cell in which you will conduct a test by clicking on the cell button bar or by clicking on the Window menu and selecting a cell.

5.3 TEST DEFINITION (cont.)

5.3.2.1 Test Description

2) Click on the Setup button at the top of the cell window. The Setup view (Screen 5-1) will appear.

3) Fill in the information for this section by clicking in the white edit boxes and typing. Each item appears on the test report.

Screen 5-1 Cell 1 Setup View

Material Description: Type in a description of the specimen to be tested in the cell.

Company Name: Type in the company name associated with the test. (**Note:** If this is first time a test will be run in the cell, the company name previously entered in the System menu will automatically be inserted.)

Operator: Type in the name of the person who will conduct the test.

Pretest Comments: Type in information particular to this specimen or the test to be conducted in the cell.

5.3 TEST DEFINITION (cont.)

5.3.2.2 Temperature Profile

Select your test Temperature Profile and Test Phase Duration according to the instructions below. These must be specified first to allow the data logging feature to provide file size estimates.

4) The CL400 can perform two types of tests: Constant temperature (isothermal) (Fig. 9) and Ramped temperature (Fig 10). Each profile type has two phases:

	<u>Pre-test Phase</u>	<u>Test Phase</u>
Constant Temperature Test	Temp. is rising to setpoint.	Dwell at setpoint temperature
Ramped Temperature Test	Temp. is rising to controlled ramp starting setpoint	Controlled temp. ramping period

In a constant temperature test, cell temperature rises (at maximum ramp rate) to a setpoint you choose and then remains there for the duration you specify under Test Phase Duration. After the test phase, cell temperature declines to ambient conditions at an uncontrolled rate.

In a ramped temperature test, cell temperature rises (at maximum ramp rate) to the Starting temperature, ramps at the specified rate up to the Ending temperature, and then cools to ambient conditions at an uncontrolled rate.

5) Select the temperature profile desired by clicking in the white dot beside either the **Constant** or **Ramped** descriptor until the black dot appears, indicating your selection (Screen 5-2). If you select Constant, you must specify Test Phase Duration, as discussed below. Test duration cannot be set for a ramped temperature test since it is determined by the selections made for Starting and Ending Temperatures and Ramp Rate.

Note: When values are inserted to define a Ramped test, the software shows a Projected Test Phase Duration. The test will not stop after that time period. The test stops after the Ending temperature is reached or it stops on error if the Ending temperature is not reached within 1 hour of the projected duration.

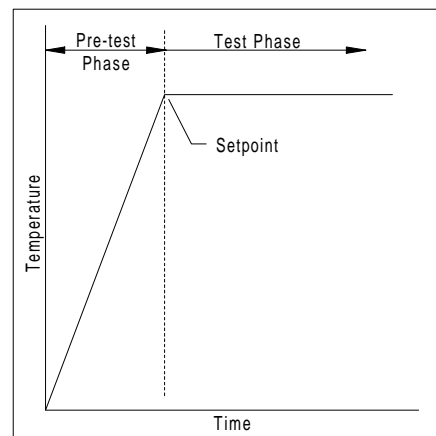


Figure 9
Constant Temperature Test Profile

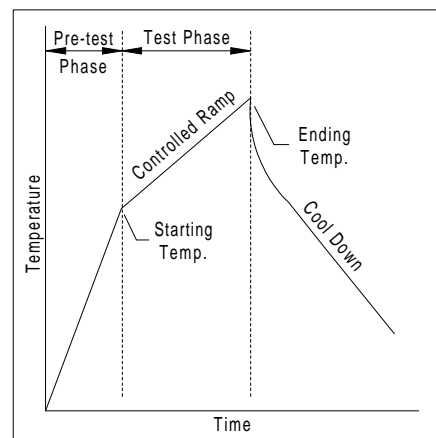


Figure 10
Ramped Temperature Test Profile

Screen 5-2
Temperature Profile Selections

5.3 TEST DEFINITION (cont.)

5.3.2.2 Temperature Profile (cont.)

6) For a constant temperature test, specify a value for the **Setpoint (°C)** by clicking in that edit box and typing the value desired, or increment the value by clicking on the indexer arrows. Maximum temperature is 250°C.

7) For a ramped temperature test, you must specify:

Starting temperature: the cell temperature to be reached before controlled ramping begins.

Ramp rate: the rate at which cell temperature is to increase during the test phase. Range: 1 to 10°C/minute in 0.1°C increments.

Ending temperature: cell temperature to be reached at the end of the test phase. Maximum: 250°C.

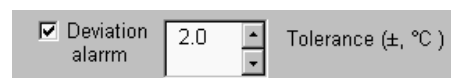
Set these values by clicking in the appropriate edit box and typing in a value, or increment a value by clicking on an indexer arrow.

5.3.2.3 Deviation Alarm

The Deviation alarm provides visual warnings in the program and Monitor windows, and flags (messages) in the data logging file when the test temperature exceeds the tolerance setting of the alarm. If the alarm is triggered by a temperature deviation, the Temperature heading in the Monitor view turns yellow and the associated Cell Status Indicator (Section 4.2) turns yellow at the lower right in the program window.

In a constant temperature test, the deviation alarm becomes active after the setpoint temperature is reached. In a ramped temperature test, the alarm is active only during the temperature ramping period (i.e., after the start temperature is reached).

8) If you desire alarm operation during the test, click on the white box beside **Deviation alarm** until a check mark appears. Set the tolerance by clicking in the white edit box and typing in a value or increment the value by clicking on an indexer arrow. Range: ± 0.1 to 10°C.



Screen 5-3
Deviation Alarm Selection

5.3 TEST DEFINITION (cont.)

5.3.2.4 Test Phase Duration

This setting, for constant temperature tests, defines how long the test cell remains at the setpoint temperature.

9) Set the Test Phase Duration by clicking in the white edit boxes for Minutes, Hours and Seconds and typing in the desired values, or increment the values by clicking on the indexer arrows (Screen 5-4). Maximum: 32,767 Hours, 59 Minutes, 59 Seconds.

Note: If you are unsure of the duration required for the test, leave the setting at the default (maximum) and then stop the test when you are satisfied with the results as observed in the Intensity graph of the Analyze view.

5.3.2.5 Gas Types

These settings allow you to select the gas type and flow rate during the pre-test and test phases of your test. You may also choose None to prevent gas flow.

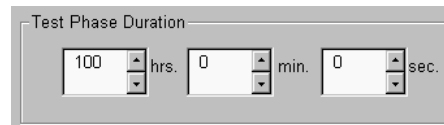
During a constant temperature test, the specimen is typically exposed to nitrogen during the pre-test phase to prevent oxidation while temperature is rising, and then is exposed to oxygen during the test phase, at setpoint temperature, to optimize oxidation. Your needs may differ and you also have a choice of two flow rates:

Low Flow = 25 ml/minute/cell
High Flow = 50 ml/minute/cell

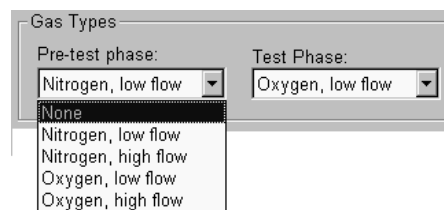
10) Select **Gas Type** by clicking on the pull-down menu button (Screen 5-5) and then clicking on the desired selection. Do this for both Pre-test and Test Phase.

5.3.2.6 Data Logging

Two methods for logging test data are available to accommodate specimens with differing light emission characteristics: Every Point and Adaptive. Secondary options allow you to set data collection preferences. You may experiment with different sampling rates and observe the Projected Data File Size.



Screen 5-4
Test Phase Duration



Screen 5-5
Gas Type Selection

5.3 TEST DEFINITION (cont.)

5.3.2.6 Data Logging (cont.)

Every Point & Sampling Rate

This method will record light intensity data points at the interval specified. This is the most appropriate method for specimens that begin emitting light early in the test phase. If this characteristic of the specimen is unknown, use this data logging method.

Adaptive & Threshold

This method records data only if the intensity level changes by the amount specified in the Threshold (mV) setting box. It is useful for specimens that begin emitting light later in the test phase and helps minimize file size.

11) Select the data logging method by clicking in the white circle beside **Every Point** or **Adaptive** until a black dot appears indicating selection (Screen 5-6). Set a value for **Sampling Rate** or **Threshold** by clicking in the appropriate edit box and typing in a value, or increment it by clicking on an indexer arrow. Observe the **Maximum Data File Size** indicated and adjust sampling rate or threshold to alter file size.

Sampling Rate Range: 1 to 32,767 seconds/reading

Threshold Range: 1 to 10,000 mV (milliVolts)

Data logging options provide the following functions:

Log during pre-test phase

If selected, data will be recorded during both the pre-test and test phases. This is useful in some cases for examining pre-test temperature performance. Selecting this option will increase data file size.

Log temperature data

Normally, only intensity data is recorded. Selecting this option will cause cell temperature data to be recorded as well. This is most useful for providing a full record of test conditions and for revealing the relationship of temperature to intensity in the timeline graph. Temperature data is always logged for Ramped tests since it is required for the analysis of ramped test data.

Data logging

Every point 30 Sampling rate (sec./reading)

Adaptive 1 Threshold (mV)

Log during pre-test phase

Log temperature data

Log status flags

Projected data file size 28 K

Screen 5-6
Data Logging Selections

5.3 TEST DEFINITION (cont.)

5.3.2.6 Data Logging (cont.)

Log status flags

Status flags (messages) are recorded in the data file to mark the occurrence of events, such as: gas status, and temperature out-of-tolerance warnings. These are useful for analyzing the test data and observing the exact time position of test events.

If this option is selected, an event will always be logged as it happens, independently of sampling rate or intensity threshold logging options. This increases data file size.

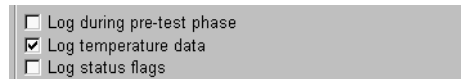
12) Select the desired logging options described above by clicking in the white box beside the appropriate ones until a check mark appears (Screen 5-7).

5.3.2.7 Saving & Loading the Test Setup

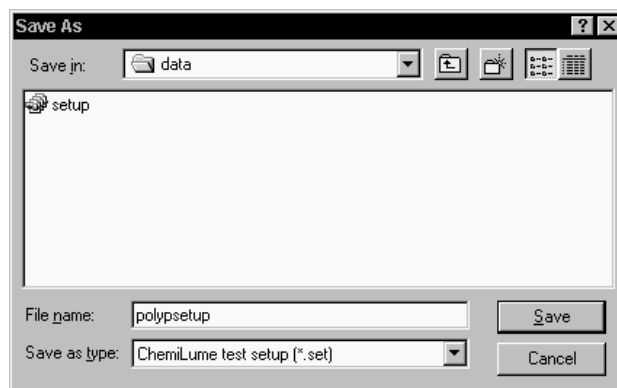
At this point, test definition for Cell 1 is complete and you may save the settings for future use. The test settings can then be loaded at a future date by clicking on the Load Setup button in any cell Setup view.

13) If desired, save the test setup by clicking on the Save Setup button and the Save As dialog box (Screen 5-8) will appear. Type in the desired file name and do not include an extension (.set is added automatically). Click on OK to save the file.

14) If you are setting up more than one test, repeat the procedure above (Steps 1 through 13) for each cell in which you will conduct a test. Otherwise, continue with the next section.



Screen 5-7
Data Logging Options



Screen 5-8 Setup Save As Dialog Box

5.4 PERFORMING A TEST

Before starting a test in the Setup view, new, empty specimen holders must be loaded into the cells. These must then undergo cell conditioning (preheat cleaning) before the actual specimens are loaded. The specimen holder cleaning is an integral, initial part of the test procedure and is initiated with the Start Test button in the Setup view (Screen 5-1). The holder cleaning at high temperature is mandatory for eliminating contaminants that can emit light during the test phase and alter results. Solvent cleaning of the holders is adequate only when conducting tests with peak temperatures below 200°C. Follow the procedure below to initiate a test.

5.4.1 Cell Conditioning and PMT Gain Settings

1) Click on the **system** button at the top of the screen to bring up the system configuration menus.

2) Bring up the Advanced Test Settings menu. Adjust the PMT Gain settings according to the instructions under Procedures for Test Setup in Section 3.4.

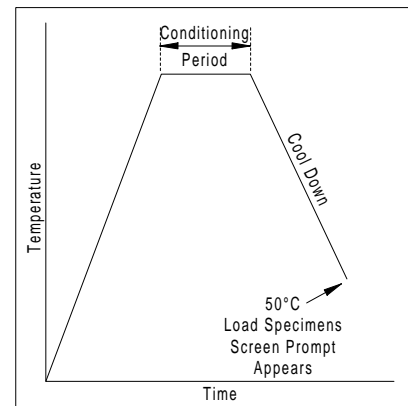
3) Bring up the Cell Conditioning menu and adjust the settings according to the instructions under Procedures for Test Setup in Section 3.5.

4) Save the new settings in the current configuration (.cfg) file by clicking on OK to exit the system configuration menus, or save to a new file by clicking on the Save As button in the System menu and naming a new file (see Section 3.8 for instructions).

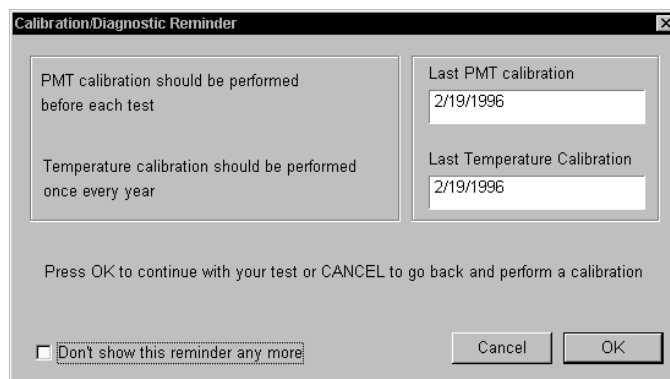
5.4.2 Cell Conditioning Phase

5) Open each cell drawer in which a test is to be conducted. Remove the cell cover (Fig. 4). Place a new, clean specimen holder into each cell and reinstall the covers. Close the drawers.

6) In the Setup view of each cell, click on the Start Test button. A calibration reminder will appear (Screen 5-9). Click on O.K.



Cell Conditioning Temperature Profile



Screen 5-9 Calibration Diagnostic Reminder

5.4 PERFORMING A TEST (cont.)

5.4.2 Cell Conditioning Phase (cont.)

7) A dialog box for entering the data logging file name will appear (Screen 5-10). Click in the edit box to the right of "File name:" and type in a suitable file name for the data logging file. Do not add an extension. It will be added automatically. Click on the Save button and cell conditioning will begin.

8) The cell conditioning requires about 2 hours to complete since the cells must be allowed to cool to at least 50°C before the specimens can be loaded. At that time, a screen prompt (Screen 5-11) will advise you to load the specimens.

Observe cell temperature in the Monitor view. Click on the Monitor button or select Monitor in the View menu.

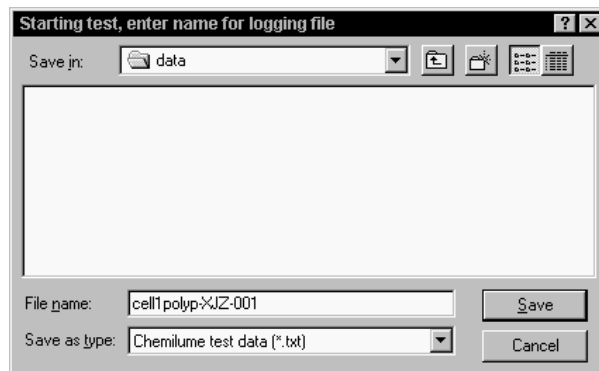


CAUTION! Burn hazard. Avoid contact with cell drawer surfaces marked by this symbol. **Don't open the drawer until it has cooled to 50°C.** Load specimens only after the cell has cooled or results may be invalidated.

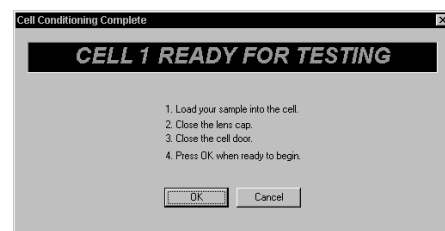
5.4.3 Specimen Preparation and Loading

The amount of specimen material used for a test must be adequate to provide reliable emission levels, yet small enough to prevent overloading of the PMT light sensor. In most cases this must be determined by trial and error. It is recommended that initial specimen weight should be in the 0.05 to 0.5 gram range, and increased or decreased for subsequent tests based on initial results. Attempts should be made to achieve intensity readings in the range of 5000 to 8000 mV (at High PMT gain).

9) Weigh and prepare your specimen materials. Maintain the cleanest conditions possible during preparation to avoid the introduction of contaminants, such as dust or skin oils, that will alter test results. Handle specimens only with clean instruments.



Screen 5-10 Test Data File Save As Dialog Box



Screen 5-11
Load Specimens Screen Prompt

5.4 PERFORMING A TEST (cont.)

5.4.3 Specimen Preparation and Loading (cont.)

10) Open a cell drawer. Remove the cell cover. Use clean tweezers to transfer specimen material from its container into the specimen holder. Clean the cell lens cover with a non-residual solvent and install it on the cell **hand-tight only**. Close the drawer. **Important:** Limit the cell open time to 2 minutes to minimize air exposure.

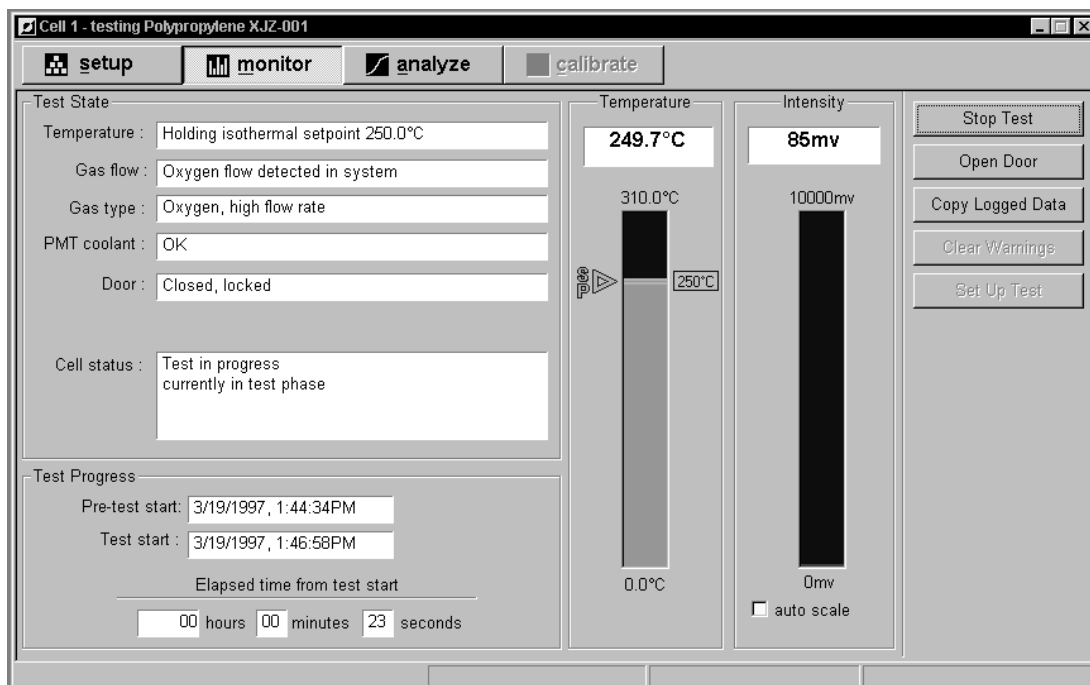
11) Repeat step 10 for each active cell.

12) Click the OK button of the screen prompt and the test will continue.

13) During the pre-test and test phases, check the gas input pressure and adjust it to 6.9 kPa (1 PSI or 16 oz/in²) if it is out of range.

5.4.4 Test Monitoring

1) During the test you may observe the status of each cell in the Monitor view (Screen 5-12). Click on the Monitor button. **Refer to Appendix A for a listing of warnings that may appear during the test.**



Screen 5-12 Cell 1 Monitor View

5.4 PERFORMING A TEST (cont.)

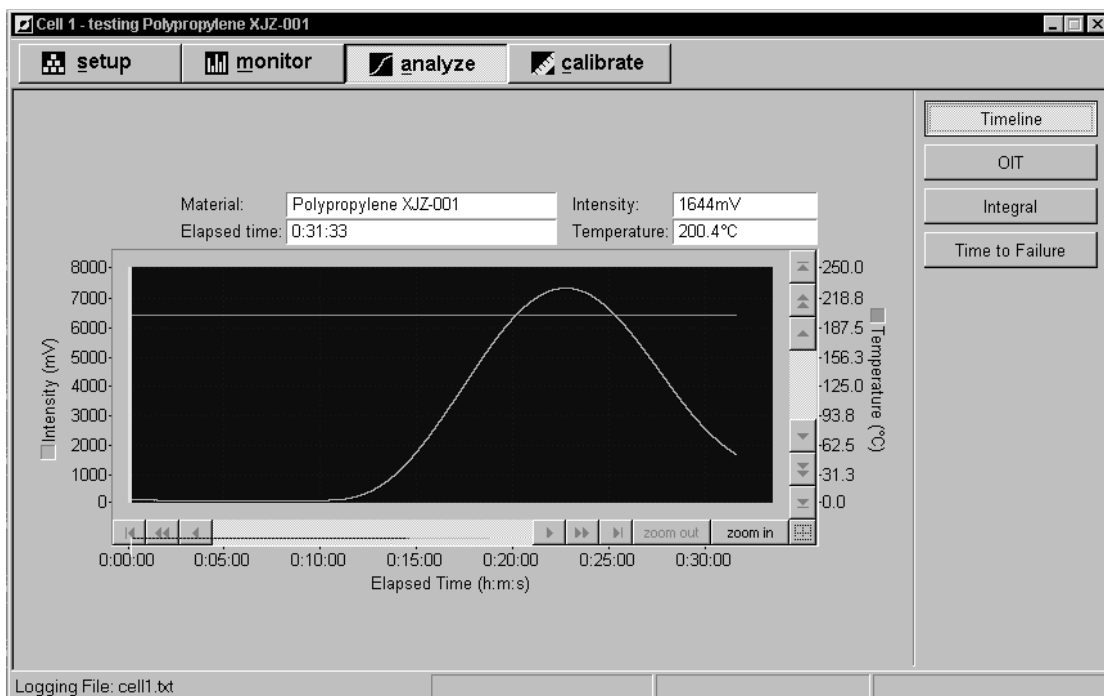
5.4.4 Test Monitoring (cont.)

2) The SP arrow beside the Temperature bar graph indicates Setpoint. If the Deviation Alarm is active, there will be two horizontal lines extending from the SP arrow. These indicate the limits of the alarm tolerance.



3) During the test phase, the Intensity bar graph is active. Select auto scale beneath the graph and the range will be reduced (from 10,000mV) to a range that will provide a taller, more responsive indicator bar.

4) While the test(s) is running, there are specific options available for examining data as it is collected, in the Analyze view (Screen 5-13), and for exporting it to another application. If you chose to Log Temperature Data in the test setup, temperature data may be observed immediately in the timeline graph. Click on the Analyze button in the cell window to observe the graph. To observe and compare the graphs of all the active cells, double click on the All Cells window icon at the bottom of the screen, or click on the Window menu and select All Cells (see Screen 5-17, next page).



Screen 5-13 Cell 1 Analyze View (Timeline Graph)

5.4 PERFORMING A TEST (cont.)

5.4.4 Test Monitoring (cont.)

5) To zoom in on a portion of the graph, click on the Zoom In button beneath the graph. The cursor will change to indicate a zoom window (Screen 5-14).

6) Move the cursor onto the near the area to be enlarged. Hold the left mouse button down and stretch the view box to enclose the area desired. Release the mouse button. Click on the panning arrow buttons to move the zoomed view to the desired position. Click on the Zoom Out button to return to a full graph view.

7) The Analyze view includes features for performing test data analyses and printing a report, covered in Section 5.5, Analyzing Test Data.

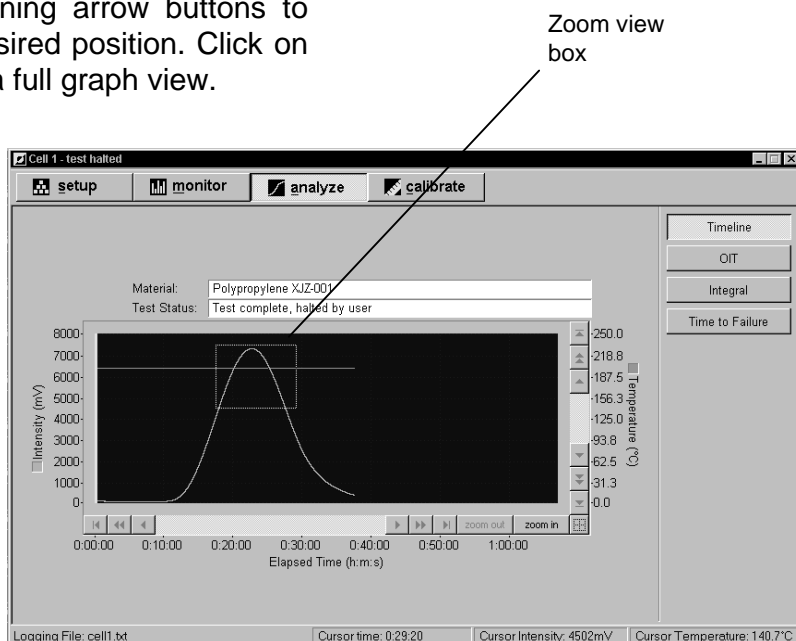
5.4.5 Exporting Data

As test data is gathered, it may be examined visually in the Analyze view or it can be copied to a file for export to another analysis program.

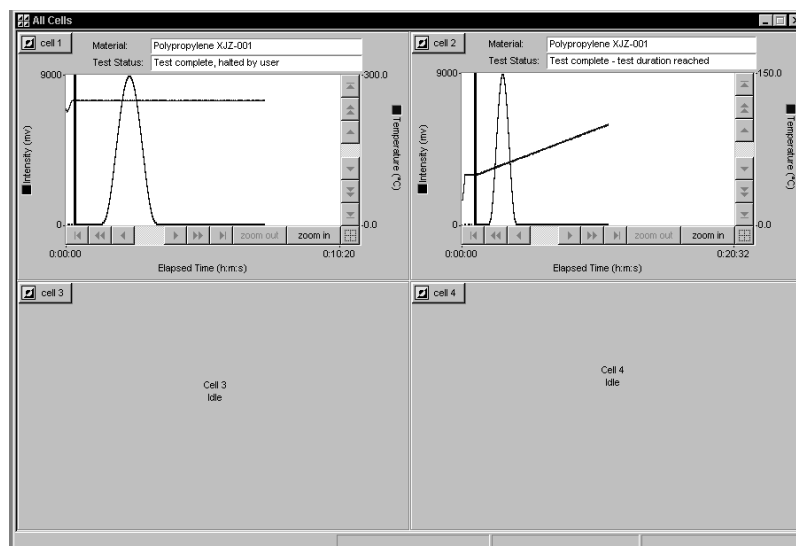
The copy procedure saves the currently logged test data and will not affect or interrupt test data logging to the file originally named at test initiation.

1) To export the test data during the test, click on the Setup or Monitor button to return to a screen that includes the Copy Logged Data button.

2) Click on the Copy Logged Data button and the Copy Data dialog box (Screen 5-16) will appear.



Screen 5-14 Zoom View Selection Box



Screen 5-15 All Cells Timeline Graph View

5.4 PERFORMING A TEST (cont.)

5.4.5 Exporting Data (cont.)

3) Data files may only be exported in ASCII (text, .txt) format. Thus, the “Save as type:” selection box may not be altered.

4) Click in the edit box beside “File name:” and type in the file name desired. Click on the Save button to save the file.

5.4.6 Test Completion & Stopping a Test

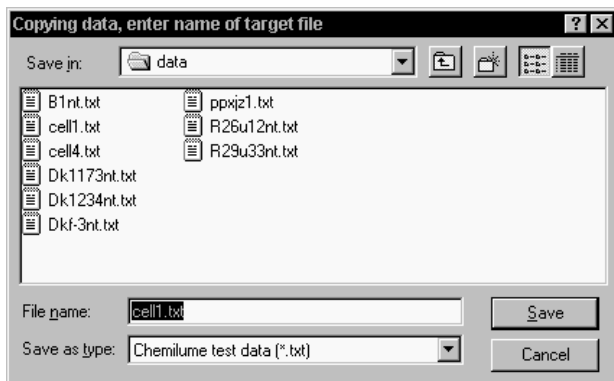
1) You may stop the test in a cell at any time by clicking on the Stop Test button in the Setup or Monitor view of that cell. The test data will be logged up to the time this occurs.

If during test setup you were unsure of the time (duration) required for your test, and the maximum duration was selected, you may stop the test with this method when intensity data has declined to a specific minimum.

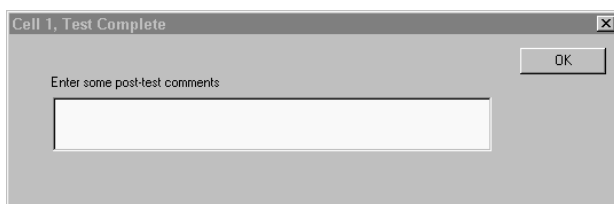
2) When a test completes, the Test Complete dialog box (Screen 5-17) will appear. If the test ended abnormally, this box will provide a status message indicating the cause. Type in any relevant information about the test process and then click on the OK button to save the comments.

NOTE: The final test conditions shown in the Setup, Monitor and Analyze views will remain until you click on the Setup Test button. This clears the views and allows you to configure and run another test in that cell while other cells may still be under test. You may wish to print a report or graph of test results, as described below, before clearing the views.

You may also print test results at a later date by opening an archived data file as described in Section 5.6.



Screen 5-16 Copy Data Dialog Box



Screen 5-17 Test Complete - Post-test Comments

5.4 PERFORMING A TEST (cont.)

5.4.7 Printing Results & Cell Reloading

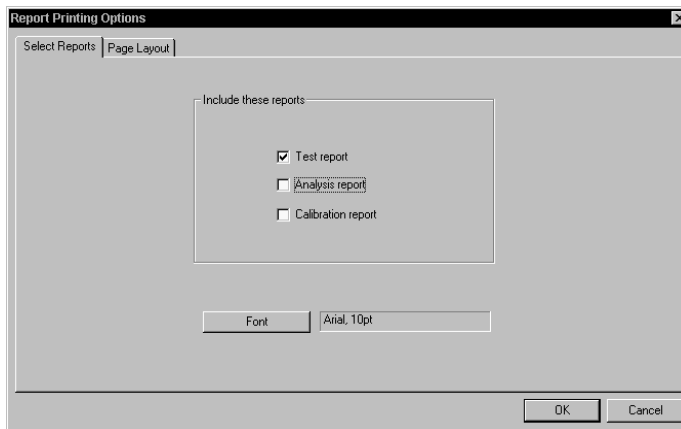
1) You may print a test report and/or a timeline graph before clearing the Setup and Analyze screens. To do so, click on the Report or Graph print button at the top of the screen or select Print from the File menu.

2) In the Printing Options menu (Screen 5-18), click on the name of the item(s) you wish to print (Test and/or Analysis Report). Click on the Page Layout button (Screen 5-19) to include headers or footers on the printout. Click on the Font button for fonts.

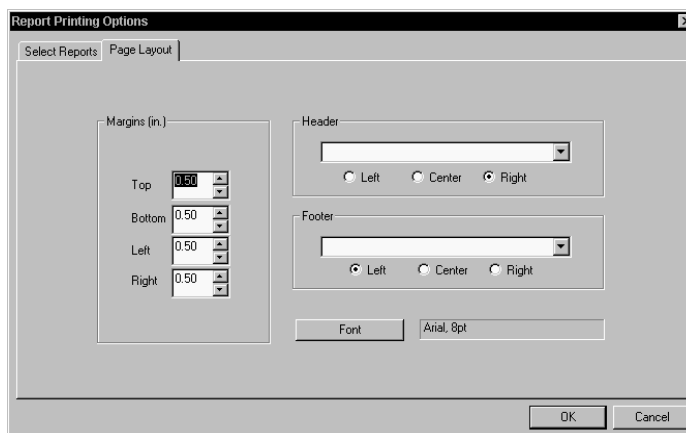
3) Customize graph printouts by using the options of the Graph Print menu (Screen 5-20). If you performed one or more analyses on the test data, you may print it at this time by following these instructions. To print the timeline alone, disable all 3 analyses results in the Graph Print - Analysis menu. Refer to Section 5.5 for instructions on performing analyses on the test data.

4) In the Graph Printing Analysis screen (Screen 5-20), select the analysis results you wish to print. Click on the results names until a check mark appears beside it.

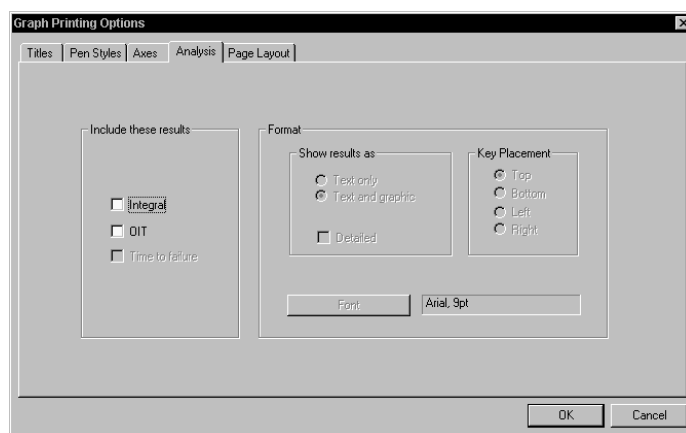
5) Graph printouts may include analysis results in text or graphical format. Selecting Text Only provides a graph and results in text form. Text and Graphic provides a graph that has coded lines indicating results as they would appear on the Analysis screen, as well as a text listing of results. Selecting Detailed provides additional information, including analysis limits, etc.



Screen 5-18 Printing Options Menu (Report)



Screen 5-19 Report Printing Options - Page Layout



Screen 5-20 Graph Printing Options - Analysis

5.4 PERFORMING A TEST (cont.)

5.4.7 Printing Results & Cell Reloading (cont.)

6) Use the Titles menu (Screen 5-21) to add titles to your graph printout. Multiple lines of text may be included. Click on the pull-down menu arrow buttons to select from a list of default titles or you may type in your own title. Click on the Font button to select fonts.

7) Use the Pen Styles menu (Screen 5-22) to define the line styles, colors and line width of the curves and indicator lines on the graph.

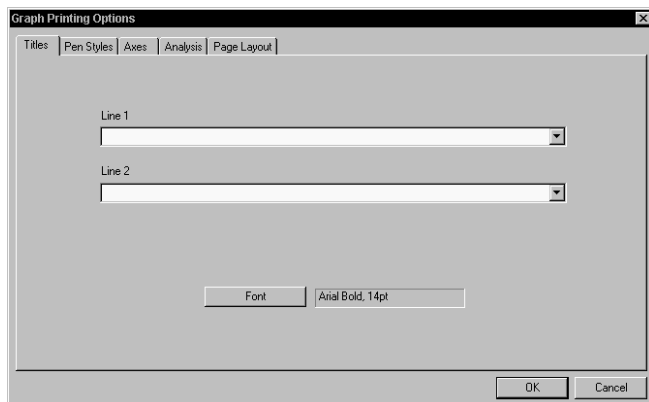
8) The Axes menu allows you to define the range of time, intensity and temperature. This permits printing expanded or compressed graphs. You may also zoom in on a detail of a graph and choose Current Viewport in this menu to print only that zoomed view.

9) To add headers or footers to the graph printout, use the Page Layout menu (Screen 5-24). Click on the Font button to select fonts.

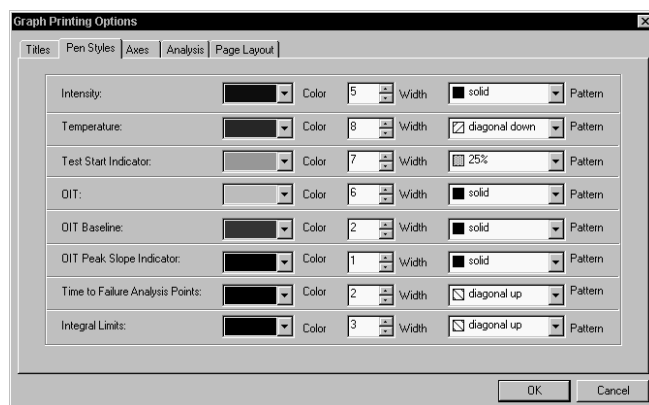
10) Print the graph by clicking on OK at the bottom of the menu.

11) You may also print test results at a later date by opening a test archive file (Section 5.6) and then performing steps 1 through 10 above, as desired.

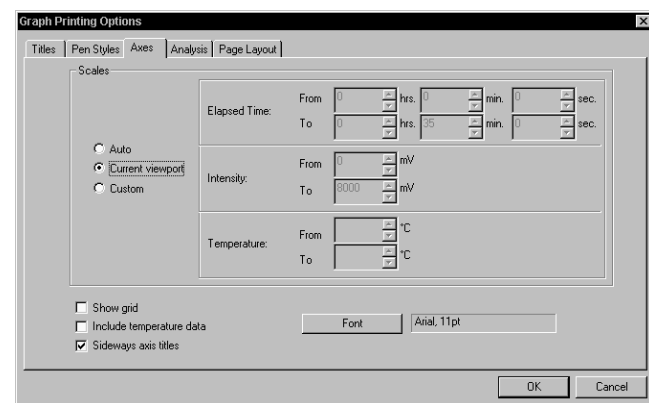
Continue below with cell unloading.



Screen 5-21 Graph Printing Options - Titles



Screen 5-22 Graph Printing Options - Pen Styles



Screen 5-23 Graph Printing Options - Axes

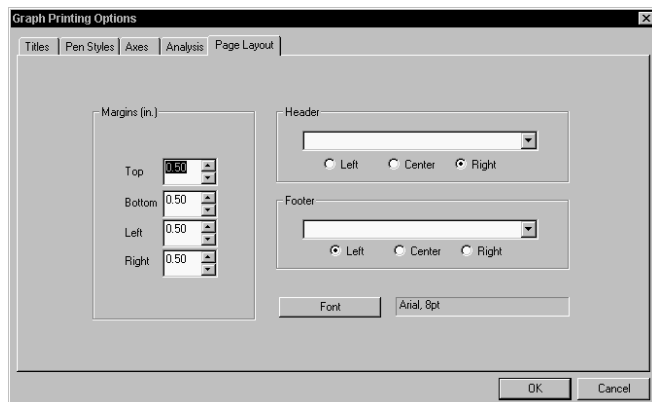
5.4 PERFORMING A TEST (cont.)

5.4.7 Printing Results & Cell Reloading (cont.)



CAUTION! Burn hazard. Avoid contact with the drawer surfaces marked by this symbol. **Do not open the cell drawer or unload used specimens until the cell has cooled to 50°C or lower.** The cell is above safe handling temperature and the drawer remains locked when the following indicators are present:

- Monitor View cell status window indicates: "Waiting for cell to cool."
 - Setpoint (S.P.) arrow is still visible in Monitor View.
 - Cell status indicator (at lower right of program screen) is purple. The indicator turns gray when the cell is cooled.
- 12) After a cell has cooled down, the drawer will unlock. Open the drawer, remove the cell cover and remove the specimen holder. Discard the holder and specimen.
- Note:** The cell cover may have seized due to high temperature exposure. You may use large pliers to open it, but take great care to avoid scratching the cover lens.
- 13) Conduct another test in a vacant cell by following the procedures of Sections 5.2 through 5.4.
- 14) Continue with Section 5.5 Analyzing Test Data for instructions on performing analyses of the test data.



Screen 5-24 Graph Printing Options - Page Layout

5.5 ANALYZING TEST DATA

This section describes how to use the Analyze view to perform four different analyses on the test data:

- 1) **Oxidation Induction Time (OIT)** - time at which light emission intensity curve begins to increase from baseline, which is the time interval to onset of exothermic oxidation of the material. Applies to constant temperature (isothermal) tests.
- 2) **Integral** - integration of area beneath intensity curve between two limits. Applies to constant temperature (isothermal) and ramped temperature tests. Yields total integrated intensity in milliVolts.
- 3) **Time to Failure*** - duration at test temperature to 50% oxidation. Applies to constant temperature (isotherm) tests. Yields induction period, oxidation rate constant and material lifetime measurement.
- 4) **Activation Energy*** - activation energy of hydroperoxide decomposition. Yields activation energy and actual temperature ramp rate.

*(based on formulae published in Luminescence Techniques in Solid-state Polymer Research, L. Zlatkevich, Ed., Marcel Dekker, NY, 1989).

Some of the analyses may be performed from partial data before a test is complete, such as OIT, Time to Failure and Activation Energy.

Please follow the procedures below for performing analyses on complete, saved data files. While it is recommended that you perform these procedures after a test is complete, they may be performed in the Analyze view while a test is running when adequate data has been recorded.

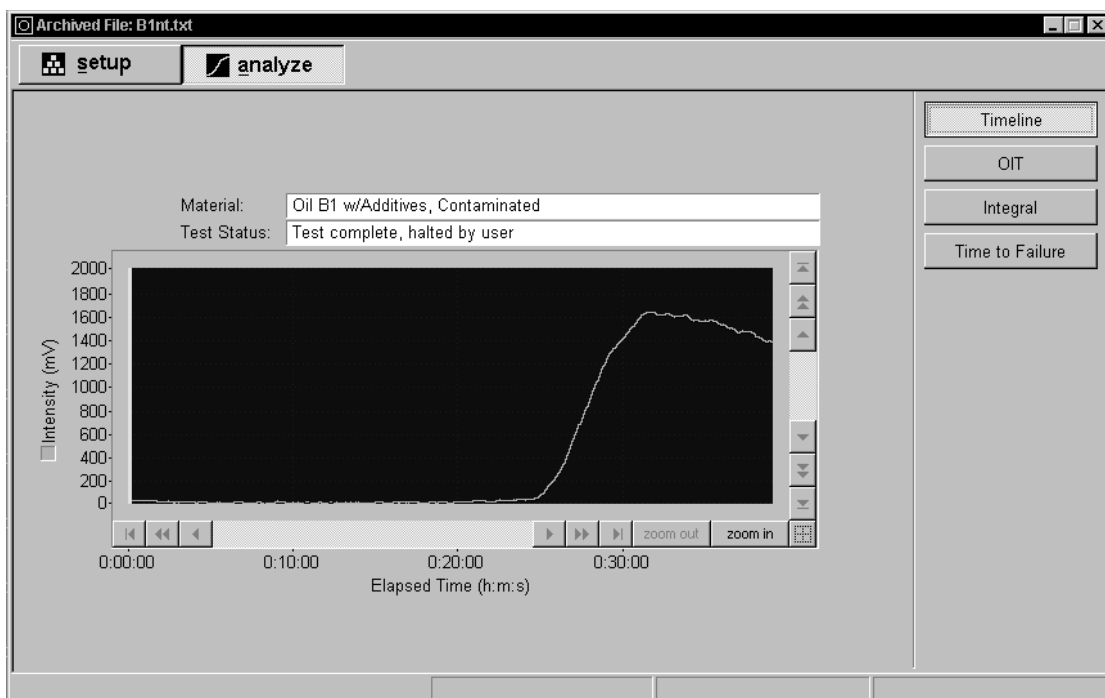
5.5 ANALYZING TEST DATA (cont.)

5.5.1 Opening a Data File

To perform an analysis, an archived data file must be opened first. This is the initial step for each analysis.

1) Click on the Open button at the top of the screen or click on the File menu and select Open and the Open File dialog box will appear.

2) Double click on the name of the test data file you wish to open or type its name in the edit box beside "File name:" and then click on the Open button. The Archived File Setup view will appear.



Screen 5-25 Archived File Analyze View

3) Click on the Analyze view button to bring up the Archived File Analyze view (Screen 5-25).

5.5.2 Oxidation Induction Time (OIT) Analysis

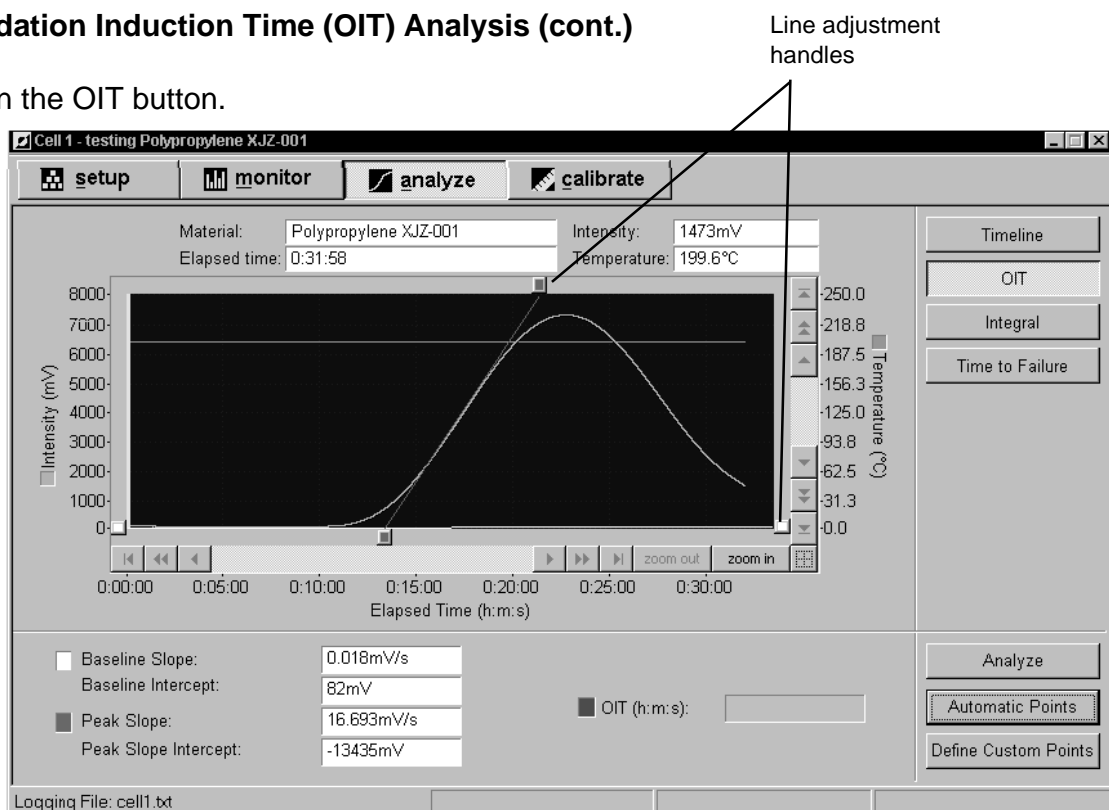
This analysis may be performed only on constant temperature (isothermal) test data.

1) Open a data file as described in Section 5.5.1 above.

5.5 ANALYZING TEST DATA (cont.)

5.5.2 Oxidation Induction Time (OIT) Analysis (cont.)

2) Click on the OIT button.



Screen 5-26 OIT Automatic Points Selection

3) To perform the analysis you must first define the baseline and the maximum slope of the intensity cure. These selections may be defined automatically or manually.

4) **Automatic Point Selection:** Click on the Automatic Points button and two lines will appear on the graph (Screen 5-26). Go to Step 7.

5) **Manual Point Selection:** Click on the Define Custom Points button and the definition lines will appear with adjustment handles.

6) Adjust each line by moving the cursor onto a handle and holding the left mouse button down. Drag the line end as required and then release the mouse button.

The horizontal line (baseline) should be adjusted to match the slope of the curve as shown, with the line passing through the center of the curve data points.

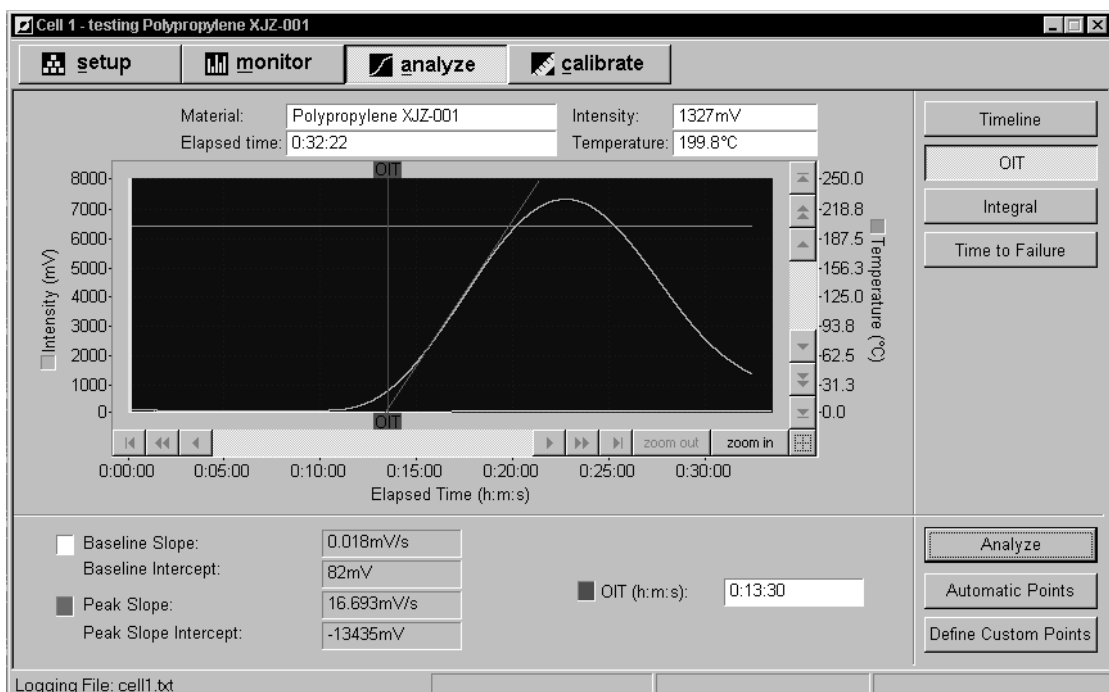
5.5 ANALYZING TEST DATA (cont.)

5.5.2 Oxidation Induction Time (OIT) Analysis (cont.)

The peak slope line should be adjusted to pass through the steepest point of the ascending curve. Both ends are adjustable to allow angling of the line.

Note: For a more detailed view of the curve when making manual point selections, click on the zoom button, move the cursor to a point just outside the area of interest, hold the left mouse button down and drag a zoom box around the area. Release the mouse button.

7) Click on the Analyze button to perform the analysis. Results are shown on the graph by the OIT line and beneath the graph in the edit boxes (Screen 5-27).



Screen 5-27 OIT Analysis Results

8) Print the results by clicking on the Graph or Report print button at the top of the program screen or by selecting Graph or Report print from the File menu. Follow the instructions of Section 5.4.7 for configuring the printing options.

9) To perform another OIT analysis of the curve, repeat the procedure above beginning with Step 3.

5.5 ANALYZING TEST DATA (cont.)

5.5.3 Integral Analysis

This analysis may be performed on constant (isothermal) and ramped temperature test data.

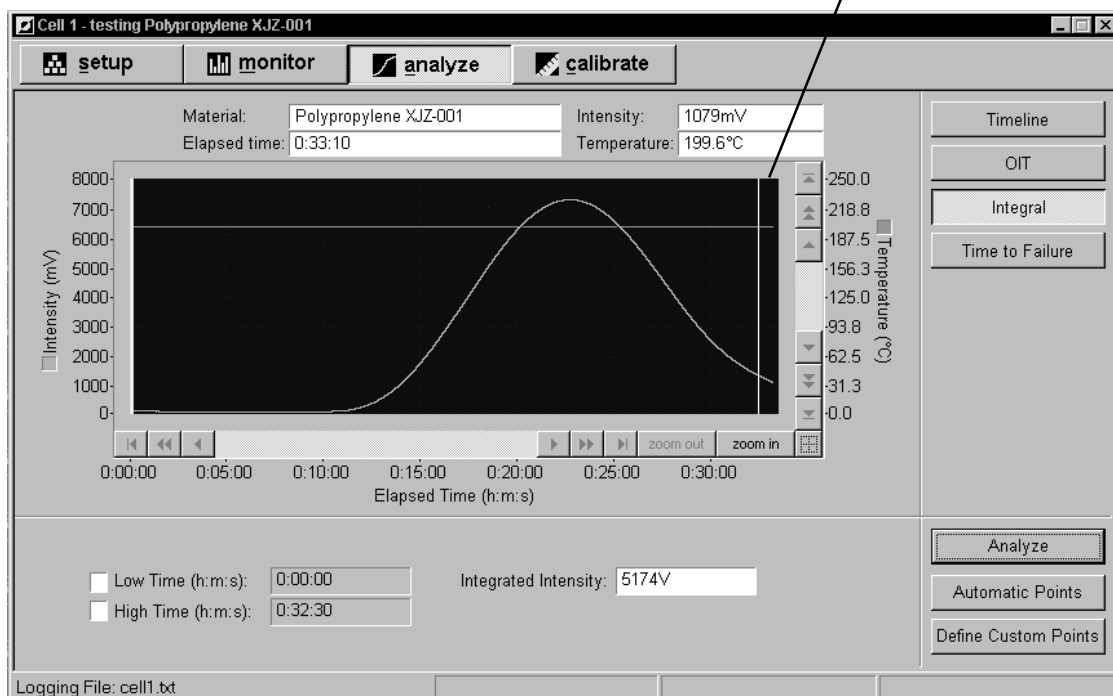
1) Open a data file as described in Section 5.5.1 above, or continue with the currently open data file.

2) Click on the Integral button.

3) To perform the analysis you must first define the limits of the intensity curve to be integrated. These two points may be defined automatically or manually.

4) **Automatic Point Selection:** Click on the Automatic Points button and two vertical lines will appear on the graph (Screen 5-28) indicating that the entire intensity curve will be integrated. Go to Step 7 if full-curve integration is desired.

Line adjustment handles



Screen 5-28 Integral Automatic Points Selection

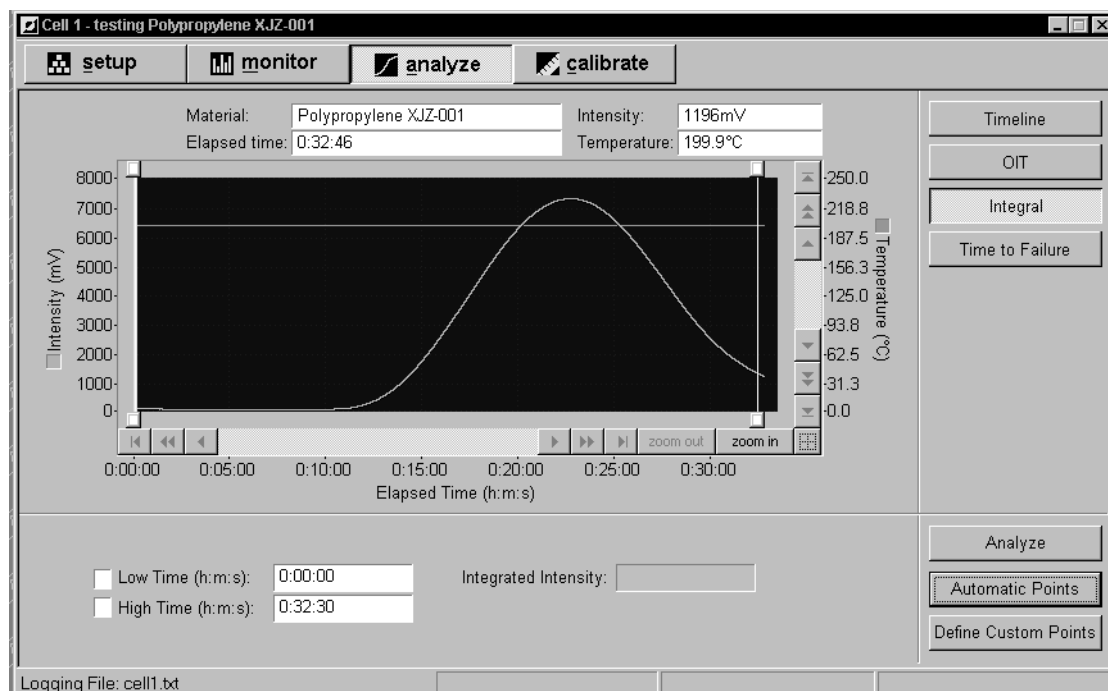
5) **Manual Point Selection:** Click on the Define Custom Points button and the definition lines will appear with adjustment handles.

5.5 ANALYZING TEST DATA (cont.)

5.5.3 Integral Analysis (cont.)

6) Adjust each line horizontally by moving the cursor onto a handle and holding the right mouse button down. Drag the line as required and then release the mouse button. Only the portion of the intensity curve between the definition lines will be integrated.

Note: For a more detailed view of the curve when making manual point selections, click on the zoom button, move the cursor to a point just outside the area of interest, hold the left mouse button down and drag a zoom box around the area. Release the mouse button.



Screen 5-29 Integral Analysis Results

7) Click on the Analyze button to perform the integration. The results are shown in the Integrated Intensity box at the bottom of the view (Screen 5-29).

8) Print the results by clicking on the Graph or Report print button at the top of the program screen or by selecting Graph or Report print from the File menu. See Section 5.4.7 to configure the printing options.

9) To perform another integration, repeat from Step 3.

5.5 ANALYZING TEST DATA (cont.)

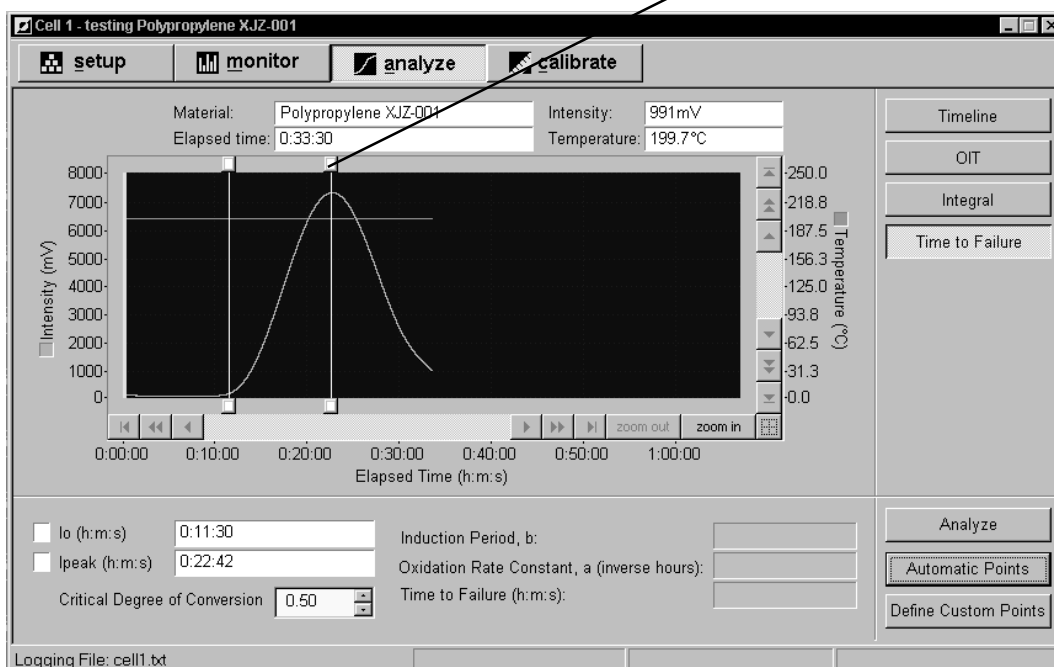
5.5.4 Time to Failure Analysis

This analysis may be performed only on constant temperature (isothermal) test data.

1) Open a data file as described in Section 5.5.1 above, or continue with the currently open data file.

Line adjustment handle

2) Click on the Time to Failure button.



Screen 5-30 Time to Failure Automatic Points Selection

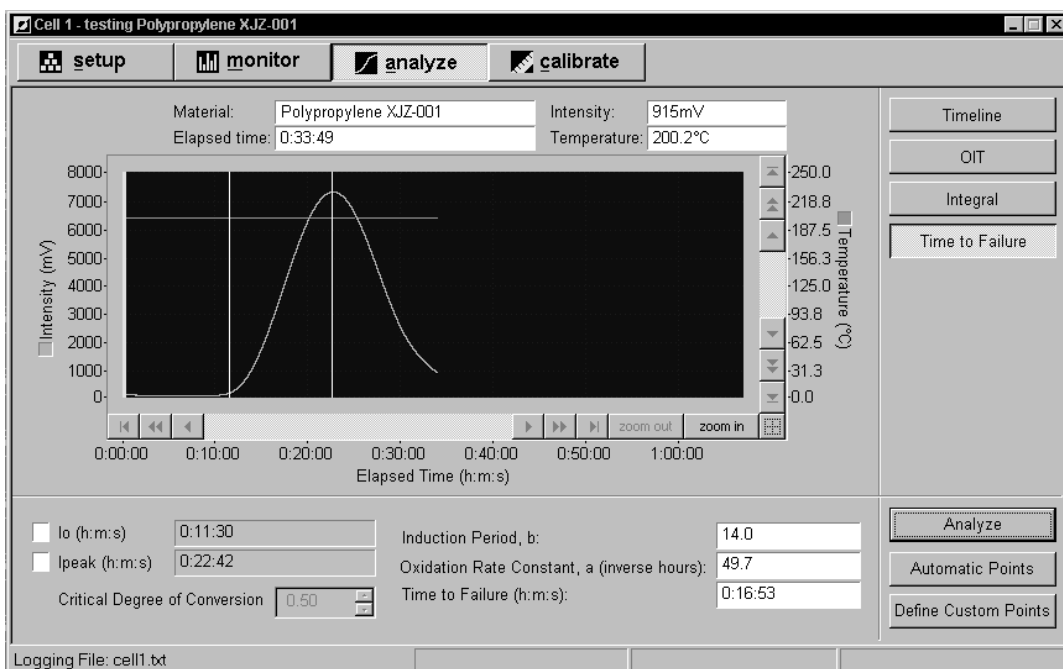
3) To perform the analysis you must define I_0 (beginning of intensity curve deviation from exotherm baseline), I_{peak} (peak value of intensity curve) and the critical degree of conversion. These values may be defined automatically or manually. When the Automatic Points option is selected, a default value of 0.50 is used for the critical degree of conversion, but this default value may be altered to your preference before initiating the analysis.

4) **Automatic Point Selection:** Click on the Automatic Points button and two lines will appear (Screen 5-30) indicating the automatically determined locations of I_0 and I_{peak} on the intensity curve. Go to Step 8 if you wish to conduct the analysis using the default critical degree of conversion value shown, otherwise go to Step 7.

5.5 ANALYZING TEST DATA (cont.)

5.5.4 Time to Failure Analysis (cont.)

5) **Manual Point Selection:** Click on the Define Custom Points button and the I_o and I_{peak} definition lines will appear with adjustment handles.



Screen 5-31 Time to Failure Analysis Results

6) Adjust each line horizontally by moving the cursor onto a handle and holding the left mouse button down. Drag the line and then release the mouse button.

Note: For a more detailed view of the curve when making manual point selections, click on the zoom button, move the cursor to a point just outside the area of interest, hold the left mouse button down and drag a zoom box around the area. Release the mouse button.

7) Select a value for the critical degree of conversion by clicking in the "Critical degree of conversion" edit box and typing in a value or by incrementing the value by clicking on an indexer arrow. Critical degree of conversion is defined as the amount of oxidation that will produce a detrimental effect in the material. It is customer-defined and based on results from experimental data and factors related to the application of the material.

5.5 ANALYZING TEST DATA (cont.)

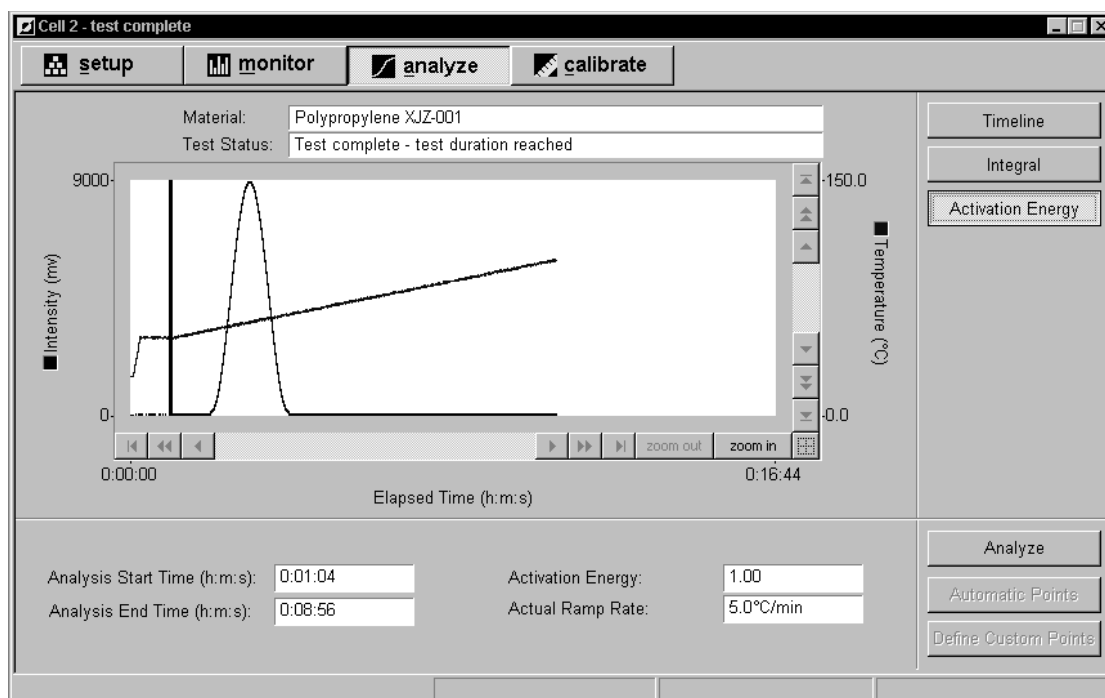
5.5.4 Time to Failure Analysis (cont.)

8) Click on the Analyze button to perform the analysis. The results are shown at the lower right of the view (Screen 5-31).

9) Print the results by clicking on the Graph or Report print button at the top of the program screen or by selecting Graph or Report print from the File menu. Follow the instructions of Section 5.4.7 for configuring the printing options.

10) To perform another analysis, repeat from Step 3.

5.5.5 Activation Energy Analysis



Screen 5-32 Activation Energy Analysis Results

This analysis may be performed only on ramped temperature test data.

- 1) Open a data file as described in Section 5.5.1 above, or continue with the currently open data file.
- 2) Click on the Activation Energy button. There are no user-adjustable setup options for this analysis.

5.5 ANALYZING TEST DATA (cont.)

5.5.5 Activation Energy Analysis (cont.)

Calculations are performed upon the data beginning at the oxygen start time (beginning of test phase) and ending at the last data point recorded (end of controlled temperature ramp).

3) Click on the Analyze button. Results are shown at the lower right of the view (Screen 5-32).

4) Print the results by clicking on the Graph or Report print button at the top of the program screen or by selecting Graph or Report print from the File menu. Follow the instructions of Section 5.4.7 for configuring the printing options.

5) To perform another analysis, repeat from Step 3.

Calibration of the PMT (photomultiplier tube) light sensors in the CL400 ensures that each is operating properly and is accurately calibrated. This must be conducted, initially, on a daily basis. After you acquire a short history of calibration results you may determine that PMT calibration is only necessary at 3 day intervals, or weekly. Examine the calibration results collected and make your own determination. PMT stability can be affected by ambient temperature fluctuations and vibration levels.

6.1 PMT INTENSITY CALIBRATION

Calibration involves placing the liquid intensity standard into a cell drawer and then initiating the test with the calibration start button. You must subsequently install a filter during the procedure to alter the standard's emission level. Text prompts on the calibration page guide you through the procedure outlined below.

Intensity Calibration Quick Reference

- 1) Standard in drawer with filter
- 2) Standard in drawer without filter
- 3) Accept or discard calibration results. Print report.

The above procedure must be carried out for each of the 4 test cells and takes about 6 to 12 minutes per cell.

Procedure

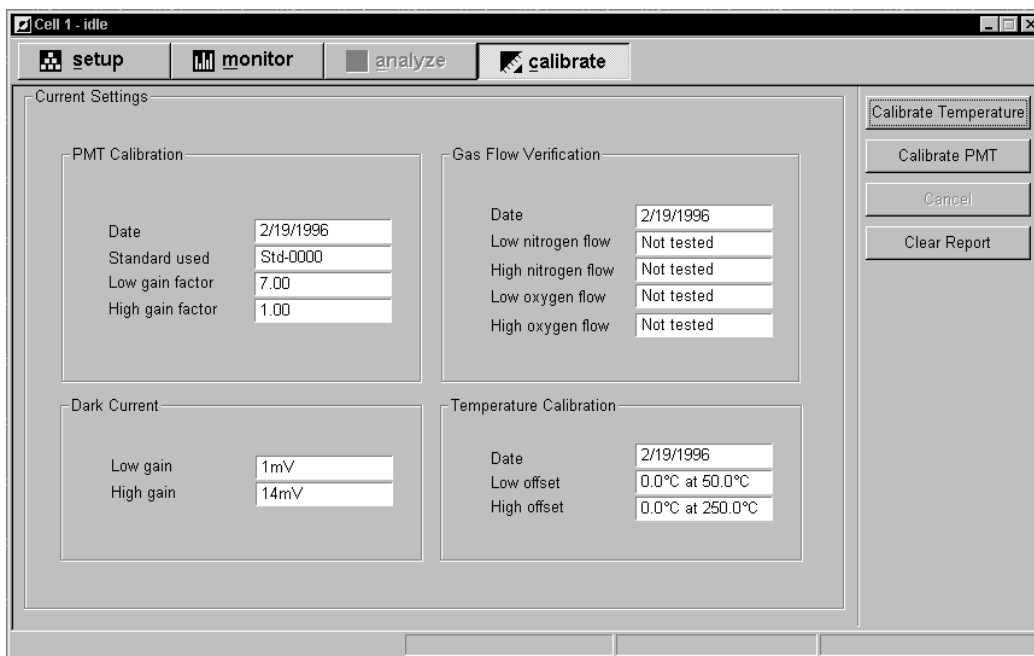
Important: The CL400 cells must be at room temperature prior to beginning the PMT calibration.



CAUTION! The intensity standard is a radioactive emission source and must be handled carefully to avoid breakage and contamination. Its output is about 8 μCi

(micro-Curies), an extremely low emission rate, but it must be handled, stored and disposed of according to local health and safety standards. In the event of breakage, avoid direct contact with the liquid. Clean up and dispose of the contamination according to applicable hazardous waste regulations.

6.1 PMT INTENSITY CALIBRATION (cont.)



Screen 6-1 Cell Calibration View - Main

Perform this calibration for each cell that will be used to conduct a test, from one to all four, as required.

1) **Important:** Verify that the intensity standard information has been recorded as described in Sec. 3.2. You will be prompted to do so by this procedure.

2) Remove the cell covers and specimen holders from each cell to be calibrated (Fig. 4). Install the intensity standard and its filter, as shown in Fig. 11, in the first cell to be calibrated. Close all the cell drawers.

3) Bring up the window for the first cell to be calibrated by clicking on Cell X in the button bar or by clicking on the Window menu and selecting Cell X.

4) Click on the calibrate button and the main Calibration screen (Screen 6-1) will appear. Click on the Calibrate PMT button and the PMT calibration screen (Screen 6-2) will appear. The dark current tests will begin immediately (an internal shutter prevents the PMT from responding to the intensity standard during the dark current test). Allow a few minutes for completion.

5) The low gain test will run automatically.

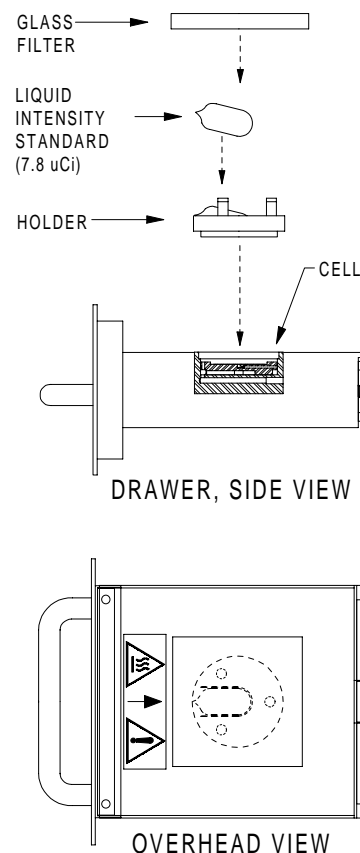
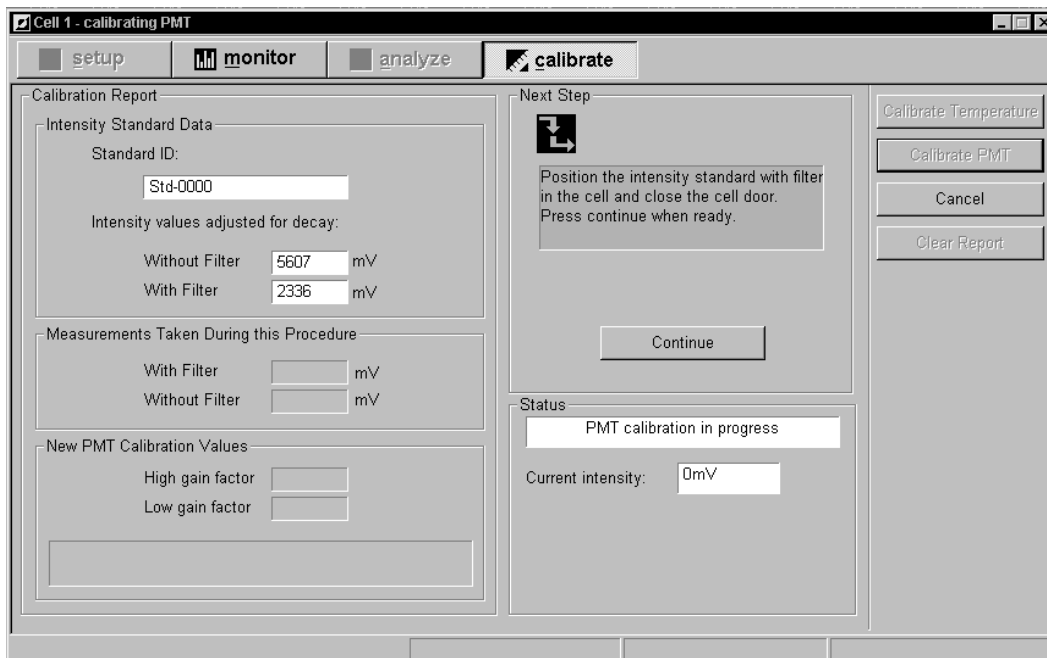


Figure 11
Intensity Standard Setup

6.1 PMT INTENSITY CALIBRATION (cont.)



Screen 6-2 PMT Calibration View

6) The screen prompt will ask you to remove the filter. Alter the setup in the cell drawer to meet this request. Close the drawer and click on the OK button.

7) When the test is complete, results are shown in the Calibration Report window (Screen 6-2). You are asked to accept the new values, if they are within specification, or to discard them if they are out of tolerance or any errors occurred. Click on the appropriate button. Accepting the new values will update only the currently loaded configuration (.cfg) file (see Sections 3.1, 3.8 and 3.9 regarding configuration file use and loading).

8) You may print a copy of the calibration report by selecting the Report print button at the top of the program window, or by selecting Print Report the File menu. The calibration report will stay open in this window until you select clear report, or you start a new test or calibration procedure.

9) Click on the OK button.

10) Close the cell window by clicking on the Close (X) button at the upper right of the cell window. Repeat steps 3 - 9 for each cell to be calibrated.