User Operation & Maintenance Manual

Spectro-FTIR Alpha Oil Analyzer



Part Number FT2055

SPECTRO INC.

User Operation & Maintenance Manual

Spectro-FTIR Alpha Oil Analyzer

Part Number FT2055

SPECTRO INC.

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Filling out the online form completes your product registration. Completing the one-page form is quick and enables Spectro to:

- Contact you with important product alerts.
- Inform you about any product updates.
- Send special product-based applications as they become available.
- Obtain needed information for processing a warranty claim.

PRODUCT SAFETY



WARNING: High voltages are present during the operation of the Spectro-FTIR Alpha! Observe all safety precautions! Turn OFF the main power switch and unplug the Spectro-FTIR Alpha before performing any work.



Software CAUTION: The Spectro-FTIR Alpha computer is capable of running multiple software applications and/or operating systems. However, as designed, the computer processor is dedicated to the operation and control functions of the Spectro-FTIR Alpha. Do not attempt to add any software or alter the original factory-installed software without checking first with the Spectro Inc. Service Department.

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Definitions

The following definitions apply to specific instructions throughout this manual.

WARNING!!!
An operating procedure or practice that may cause injury if not carefully observed or followed.

CAUTION!!!
An operating procedure or practice that may cause damage to the Spectro-FTIR Alpha if not carefully observed or followed

NOTE!!!
An operating procedure or practice that is essential to emphasize

Revision History

Original	v.1.0	19 October 2009, First Issue
Change 1	v.1.1	1 December 2009, added Chapter 4 plus minor corrections
2		

Total Number of pages in this manual is 54 consisting of the following:

Description	*Page*	*# of Pages*
Covers		*2*
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Chapter 1

Description & Setup

1.0 DESCRIPTION & SETUP

The Spectro FT-IR Oil Alpha Analyzer, Figure 1.0-1, is specifically designed for the molecular analysis of lubricating oil to determine oil degradation and contamination. It was developed and optimized for predictive maintenance programs according to JOAP, ASTM E2412 and DIN standards for the rapid determination of oxidation, nitration, sulfation, water, coolant, fuel dilution, soot, wear additive depletion and synthetic lubricant breakdown in used lubricating oils.

The Spectro-FTIR Alpha uses an innovative patent pending flip-top cell to introduce and analyze the sample. Sample introduction is thus extremely simple, reliable and eliminates the need for a peristaltic pump and solvents.

The Spectro-FTIR Alpha is a bench-top instrument that requires little counter space for operation. This chapter details the installation and operational requirements for routine sample analysis. It also describes the major components and assemblies to familiarize the operator with the instrument.

1.1 SITE REQUIREMENTS

The site where the Spectro-FTIR Alpha is setup for operation must be properly planned and prepared to optimize the analysis of oil samples. To save time during installation, the site can be prepared prior to the arrival of the Spectro-FTIR, or it can be performed at the same time.



Figure 1.0-1, Spectro-FTIR Alpha

The Spectro-FTIR Alpha is a bench-top instrument and can be placed on a laboratory counter or a separate table. The comfort of the operator must also be considered if samples are to be analyzed for long periods of time. The physical requirements for the laboratory are as follows:

- **Location**: The Spectro-FTIR Alpha must be placed on a level surface.
- It is always good practice to place instruments away from windows or doors where direct sunlight or drafts could cause temperature fluctuations.
- **General Space Considerations:** The spectrometer itself needs less than one square foot of laboratory counter space. The computer to operate the Spectro-FTIR Alpha must also be taken into account when determining the total required bench space.
- **Operating Temperature:** Minimum to maximum 18-35˚C (64-95˚F). Temperature fluctuations of more than 1 ˚C shift during a sample measurement and 2˚C shift between background measurements are not recommended for optimum accuracy and repeatability.
- **Humidity:** For optimum performance life the operational relative (non-condensing) humidity should be ≤ 80%. An optional purge kit is available for high humidity environments.

IMPORTANT NOTE: The Spectro-FTIR Alpha must be placed as far away as possible from any sources of vibration within the confines of the laboratory. Due to the sensitive nature of the instrument, the unit should be isolated from any source of vibration during analysis (Spectroil M, ventilation hoods, motors elevators, air conditioners, etc.

The resources and facilities external to the Spectro-FTIR Alpha that are required for operation are:

- Minimal Electrical Requirements: 100-240 VAC ±10%, 50-60 Hz.
- **Computer** (when not supplied by Spectro Inc): Minimum requirements are Pentium 2 @800 MHz, 128MB RAM, 10GB Hard Disk, (2) RJ-45 Ethernet ports. With an English operating system of either; Windows XP or Windows 2000.

Important Consideration:
To provide for good data quality and a long spectrometer service life, ensure that the following site requirements are met:

- Do not install the spectrometer near sources of potential inductive electrical interference (e.g. pumps, switching motors, microwave ovens etc.), sources of high energy pulses, and sources that might cause magnetic or radio frequency interference.
- Do not place devices such as large electric motors, heaters, welding equipment, radio transmitting equipment, units emitting pulsed NMRs, or high powered lasers in close vicinity to the spectrometer. These devices can interfere with the spectrometer and cause spectrometer malfunction. Ensure that these types of devices are not connected to the same electrical circuit as the spectrometer.
- If there are any problems concerning main power supply (e.g. brownouts, power surges, frequent thunderstorms), take precautions to ensure an uninterruptible power supply.

1.2 SPECTRO-FTIR ALPHA HARDWARE DESCRIPTION

This chapter identifies the main components of the Spectro-FTIR Alpha. The user should become familiar with the terminology in order to make it easier to understand the operational and maintenance functions of the instrument as described in this manual.

1.2.1 Spectro-FTIR Alpha Basic Components

The Spectro-FTIR Alpha is a modular system that requires only an external computer for operation. The basic module contains the IR source, interferometer, beam splitter, windows detector, and power supply. The main components used in routine operation are shown in Figure 1.2-1.

1. **Basic Spectro-FTIR Alpha Module** - contains integrated electronics and optics.
2. **Lock/release Lever** - to remove the measurement module.
3. **Measurement Module** - contains the flip-top sampling cell.
4. **Sample Compartment Lid.**

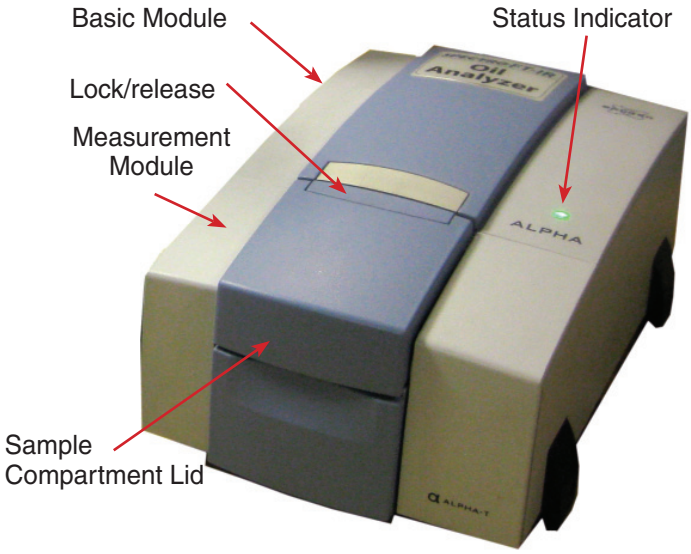


Figure 1.2-1, Basic Spectro-FTIR Alpha Components

5. **Status Indicator**:
   - green when ready for the analysis of samples
   - grey in standby mode
   - yellow during warm-up.

1.2.2 Spectro-FTIR Alpha Connecting Ports

The Spectro-FTIR Alpha connecting ports for power, ethernet, etc. are located on the bottom rear of the basic unit, Figure 1.2-2.

1. **USB Port** - Not used on the Spectro-FTIR Alpha.
2. **ETH/LAN Port** - The Ethernet / Local Area Network port is used to connect the Spectro-FTIR Alpha to a computer on which the Opus and Spectro Oil Analysis software is installed. The port is designed for an RJ-45 plug and complies with the Ethernet standard. In its simplest form, the spectrometer is connected to its own computer using the supplied cross over Ethernet cable. See also Section 1.3 of this manual for alternative computer connections.
3. **TKD Led** - The Take Data led indicates that the interferometer mirror is within the data acquisition range. When data acquisition actually takes place, the light intensity changes to bright green.
4. **ACC Led** - The Access led indicates that the network is accessing the spectrometer optics. During transition of measuring data, the led will be light yellow.
5. **DIR/ERR Led** - The Direct Error led flashes slightly red during normal operation to indicate scanner movement. If the led is solid bright red, there is an interferometer problem such as no laser signal.
6. **Ext Accessory Port** - A port that can be used to connect optional accessories. The Spectro-FTIR Alpha does not require any accessories for normal oil analysis.
7. **TAP Port** - The Test Access Port is used for service and diagnostics.

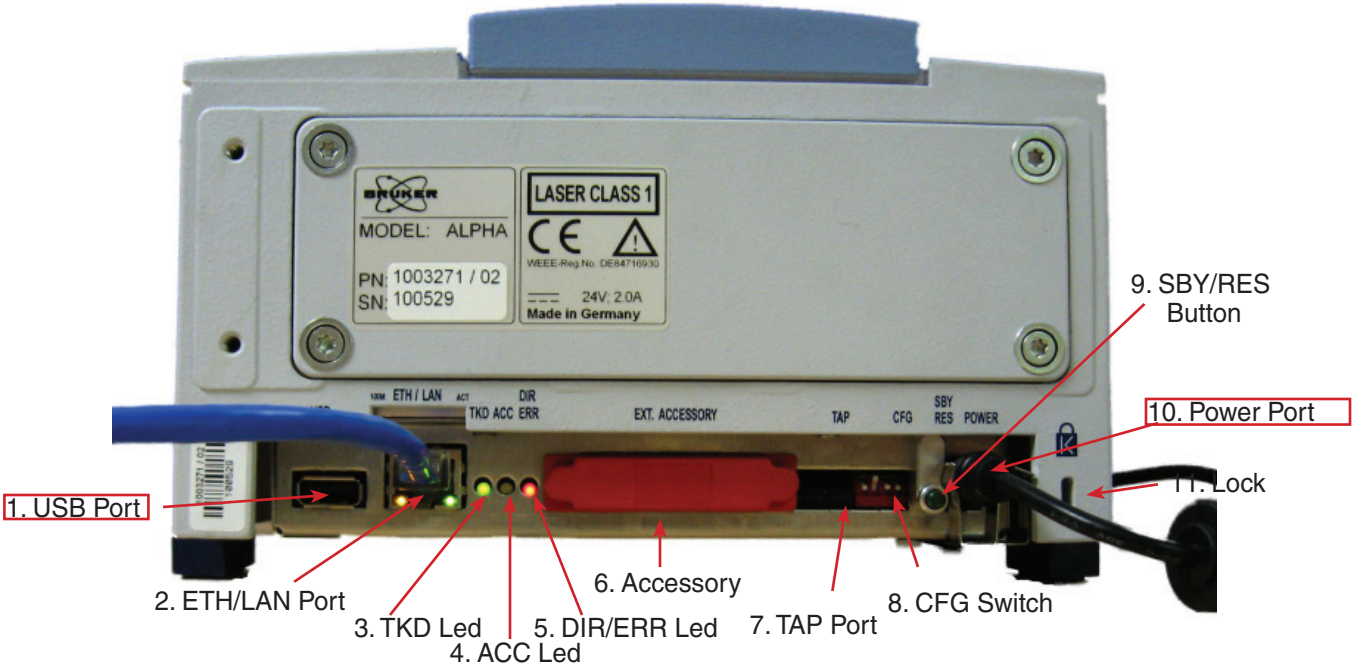


Figure 1.2-2, Spectro-FTIR Alpha Rear View

8. **CFG Switch** - The Configuration switch is a fourfold DIP switch with settings as follows:
   - #1 ON and #2 OFF: DHCP mode - use last DHCP address.
   - #1 OFF and #2 ON: use ON-IP address 10.10.0.1
   - #3 and #4 are not used for oil analysis applications.
9. **SBY/RES Button** - The Stanby / Reset button will either activate/deactivate the standby mode or reset the spectrometer depending on how long it is pressed. If pressed for about 2 seconds, the standby mode is activated or deactivated. If pressed for more than 6 seconds, the spectrometer will reset to restore its initial state.
10. **Power Port** - Connects the spectrometer to the power supply with the provided adapter. A clip on the spectrometer is used to hold the adapter in the connector,
11. **Kensington Lock** - An optional locking capability similar to those used for personal computers.

1.3 SPECTRO-FTIR ALPHA HARDWARE INSTALLATION

Your local Spectro Inc. representative usually carries out unpacking and installation of your Spectro-FT-IR. The process is, however relatively simple and straight forward. The standard components delivered with the Spectro-FTIR Alpha along with their part number are shown below:

- FTIR 31150, Spectro-FTIR Alpha
- Power adapter (part of FTIR)
- FT2027, Flip-Top Cell Assembly
- FT2003, FTIR Oil Analysis Software
- OPUS Software (part of FTIR)
- FL310, IR Check Fluid
- FL306, Disposable Non-Abrasive Cleaning Pads
- FT2055, User Manual

1.3.1 Installing the Spectro-FTIR Alpha

Installation of the Spectro-FTIR Alpha is a two-step process. First the spectrometer must be unpacked and and connected to the power mains as described in this section. Next the spectrometer must be hooked up to one of three alternative computer setups as described in the next section.

To install the spectrometer, locate the power adapter and connect it to the power port, item 10 in Figure 1.2-2. Note that there is a clip on the spectrometer to securely hold the power connector in place. Plug the other end of the power adapter into the mains power supply.

The status indicator light will be yellow for about 7 minutes while the IR source warms up. If the status light is grey when the power is hooked up, then the unit is in the standby mode, press the **SBY/RES** button at the rear of the spectrometer for about 1 to 2 seconds to change to the operating mode.

1.3.2 Connecting the Spectro-FTIR Alpha to a Computer

The Spectro-FTIR Alpha is connected to a computer (PC) through an Ethernet cable. There are three connection topologies to choose from depending on your laboratories' requirements.

a. Stand-alone Configuration (Standard)
b. Spectro-FTIR Alpha and its PC connected to a network
c. Spectro-FTIR Alpha connected to a network computer

The Ethernet cable used to connect the Spectro-FTIR Alpha to a PC depends on the selected topology. A cross-over cable is required for the stand-lone configuration and a standard cable for all others. The difference in Ethernet cables is shown in Figure 1.3-1.

NOTE: The OPUS and Spectro Oil Analysis software must installed onto the computer. Both programs will be pre-loaded if the computer is purchased from Spectro Inc., otherwise, see Chapter 2 for software installation instructions.

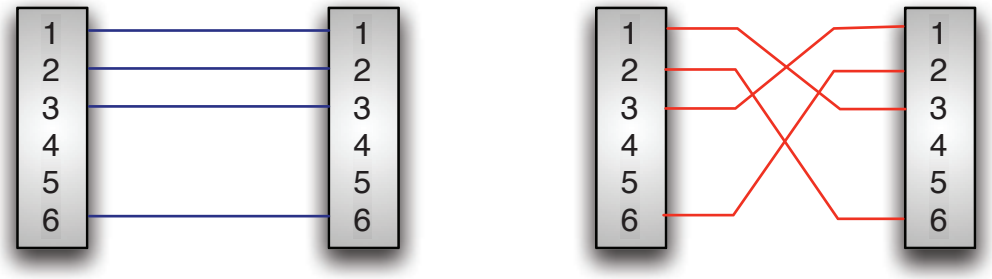


Figure 1.3-1, Ethernet Cables Used in Spectro-FTIR Alpha Computer Topologies

1.3.2.1 Stand-alone Configuration

This is the standard configuration where the Spectro-FTIR Alpha is connected to a PC, i.e. neither the Spectro-FTIR Alpha or the PC are part of a network. This configuration requires a cross-over cable to connect the Spectro-FTIR Alpha to the PC as shown in Figure 1.3-2. The cable is connected to the Ethernet connector on the Spectro-FTIR Alpha and the other end to the network card Ethernet RJ-45 connector on the PC.

The stand-alone configuration has the following advantages and disadvantages:

Advantages:

- Easy to install
- Full bandwidth available for the data transfer between Spectro-FTIR Alpha and PC.
- No access conflicts with other PCs that may try to access Spectro-FTIR Alpha as well.
- No data transfer rate problems.

Disadvantages:

- No remote access to Spectro-FTIR Alpha from other PCs on which OPUS is installed.
- No computer network connection
- A local printer is required to print out the measurement results.

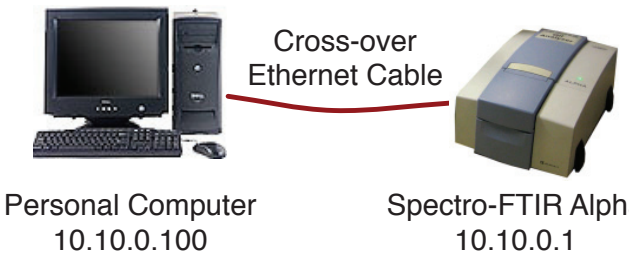


Figure 1.3-2, Stand-alone Configuration

1.3.2.2 Spectro-FTIR Alpha and PC on a Network

In this configuration, both the Spectro-FTIR Alpha and its PC are connected directly to a network. Standard Ethernet cables are used in this configuration to connect both systems to a network hub, Figure 1.3-3.

The stand-alone configuration has the following advantages and disadvantages:

Advantages:

- Remote access to Spectro-FTIR Alpha via internet or the intranet is possible.
- The PC can access to all network resources (provided you have the corresponding access rights).

Disadvantages:

- Your network administrator must be involved in configuring the connection.
- Only a fraction of the bandwidth is available for the data transfer between Spectro-FTIR Alpha and PC. Due to data transmission delays, the measurement time may increases.
- Access conflicts caused by other PCs that try to access Spectro-FTIR Alpha as well.

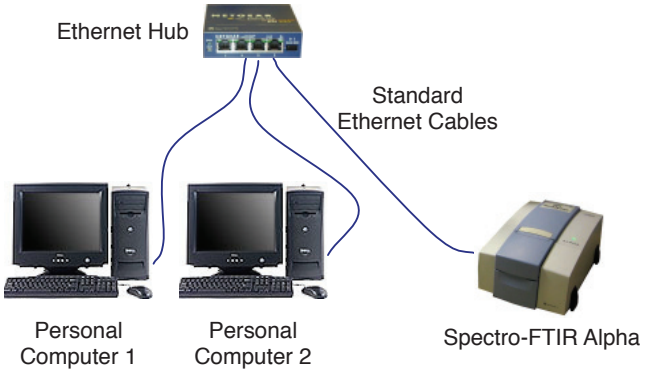


Figure 1.3-3, Spectro-FTIR Alpha & PC on a Network

1.3.2.3 Spectro-FTIR Alpha on a Network Computer

This configuration combines the advantages of the other two configurations, however, it requires additional hardware and is the most difficult to install. The configuration is shown in Figure 1.3-4.

The stand-alone configuration has the following advantages and disadvantages:

Advantages:

- Full bandwidth available for the data transfer between Spectro-FTIR Alpha and PC.
- Remote access to Spectro-FTIR Alpha via internet or intranet is possible (provided you have the corresponding access rights).
- The PC can access to all network resources (provided you have the corresponding access rights).
- Different data transfer rates for the data exchange between Spectro-FTIR Alpha (10Base-T)and the network (no restriction) are possible.

Disadvantages:

- Your network administrator must be involved in configuring the connection.
- A second network interface card (supplied with the instrument) is required for the PC controlling the spectrometer.

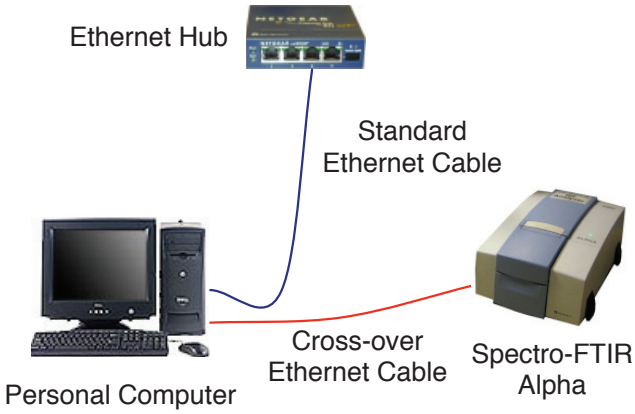


Figure 1.3-4, Spectro-FTIR Alpha on a Network Computer

1.4 OPERATING THE SPECTRO-FTIR ALPHA

The Spectro-FTIR Alpha analyses used oil samples with the Spectro Oil Analysis Software. See Chapter 2 for installation of the software and Chapter 3 for routine sample analysis.

In routine operation the Spectro-FTIR Alpha can be set to the stand-by mode when not in use, or it can be completely disconnect from the mains supply by unplugging the power cord. It is recommended to set the spectrometer to the stand-by mode overnight. Only in case of longer shut-down periods (e.g. several days) is it advisable to completely disconnect the spectrometer from the mains supply.

When the Alpha is in stand-by mode, it is not completely switched off. There is still some minimal power consumption but the IR source, laser and detector are switched off.

To set the Spectro-FTIR Alpha to the standby mode:

1 Press the **SBY/RES** button, Figure 1.4-1, at the spectrometer rear side for a short time (about 1 to 2 seconds).

2. The spectrometer will beep and the green status indicator on the spectrometer top side begins

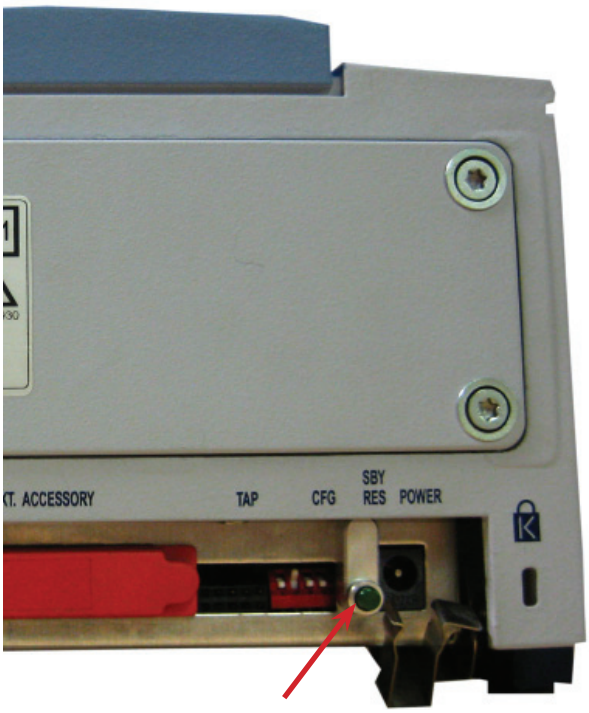


Figure 1.4-1, STANDBY/RESET Switch

to flash in short intervals. The status light then switches to grey.

To reset the Spectro-FTIR Alpha to the operating mode after being in standby:

1. Press **SBY/RES** button at the spectrometer rear side for a short time (about 1 to 2 seconds).

2. The spectrometer beeps and the laser, IR source and detector are switched on.

3. As the IR source warm-up (about 7 minutes), the spectrometer status indicator turns yellow.

4. When the IR source has reached its operating temperature, the spectrometer status indicator changes to green.

Chapter 2

Initial Software Setup

2.0 INITIAL SOFTWARE SETUP

For operation, the Spectro-FTIR Alpha must have two software programs installed on its personal computer (PC) along with some specific settings for proper communication between the spectrometer and the computer. The software and settings will be pre-installed at Spectro Inc. when the computer is supplied along with the Spectro-FTIR. The instructions in this chapter must be followed in sequence when the customer supplies their own computer, or if the original computer needs to be replaced.

This chapter details the installation and setup instructions for the OPUS Software, the Spectro FTIR Software, and software configuration requirements.

2.1 SETUP OF NETWORK CARD

The Spectro-FTIR Alpha can be used in two operating modes, either as a standalone system operated by its (PC), or as an integral part of a laboratory information system (LIMS) such as LabTrak.

When the Spectro-FTIR Alpha is used as a standalone system, the network card supplied with the computer can be used to communicate with the spectrometer. The network card in the PC is connected to the Spectro-FTIR Alpha with a crossover Ethernet cable. Proceed with Step 1 to configure the network card.

When the Spectro-FTIR Alpha and its PC is used in a network, an additional network card (supplied with the system) must be installed. Install the card in the PC with the instructions provided with the card or the PC. The installed network card in the PC is connected to the Spectro-FTIR Alpha with a standard Ethernet cable. Proceed with step 1 to configure the network card.

1. To configure the network card, open the Windows XP Control Panel and double left click on "**Network Connections"**.

2. Right click on the network card (Local Area Connection) that you plan to use to communicate with the Spectro-FTIR. Select "**Properties**" from the drop-down menu, Figure 2.1-1.

NOTE: As long as the network port is used with the Spectro-FTIR, it does not matter which network card

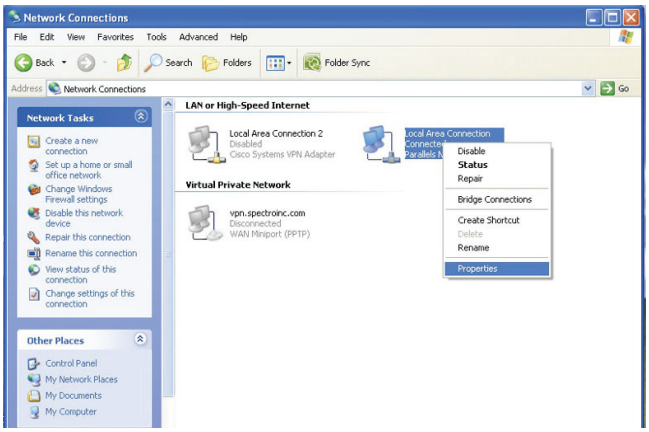


Figure 2.1-1, Network Connections screen

you select if there are more than one.

3. Make sure the "**General**" tab is selected and scroll down to "**Internet Protocol (TCP/IP)**", Figure 2.1-2.

4. Select "**Internet Protocol (TCP/IP)**" by double-clicking on it or by selecting "**Properties**" and clicking on it. The screen shown in Figure 2.1-3 will appear.

5. On the "Internet Properties (TCP/IP)" screen, select the radio button for "**Use the following IP address:**" by clicking on it.

6. Enter the IP address of "**10.10.0.100**" and Sub Mask address of "**255.0.0.0**" as shown in Figure 2.1-4. The Subnet mask address can also be entered automatically by pressing the "**Tab**" key after the IP address is entered. Click on "**OK**" to save the configuration and "**Close**" to close the screen.

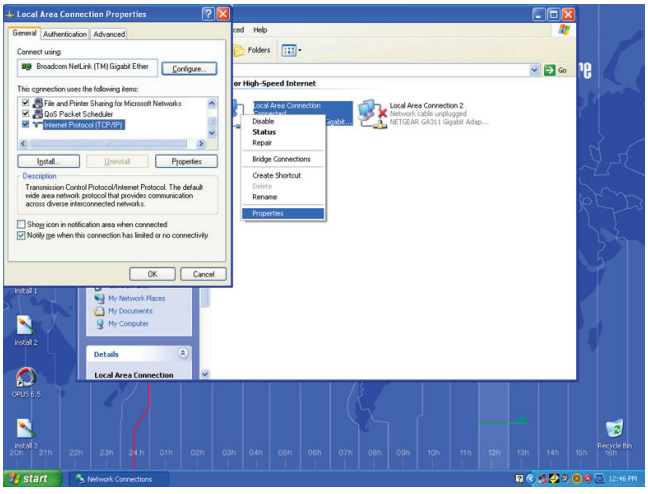


Figure 2.1-2, General Tab and Internet

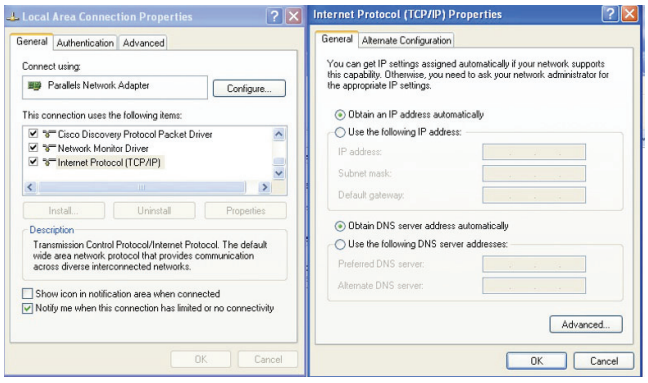


Figure 2.1-3, Internet Protocol Properties Screen

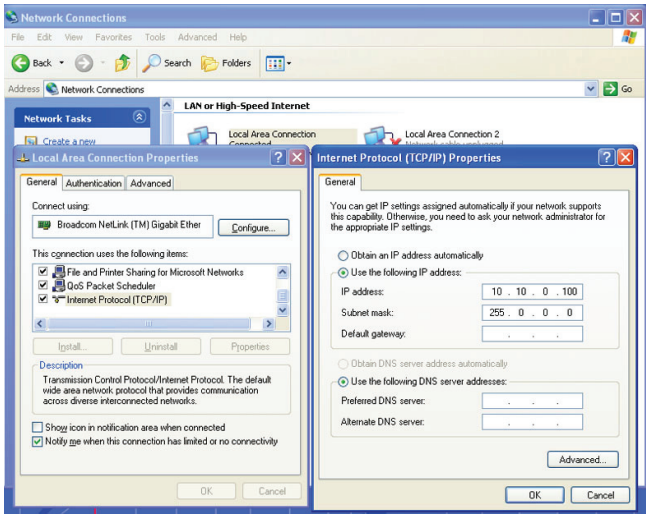


Figure 2.1-4, IP ans Sub Mask Addresses Entered

7. After completion of the configuration process, if the Spectro-FTIR Alpha is connected, the Local Area Connection just configured will be enabled and will show as "connected" on the Network Connection screen Figure 2.1-5.

8. This completes the network card setup.

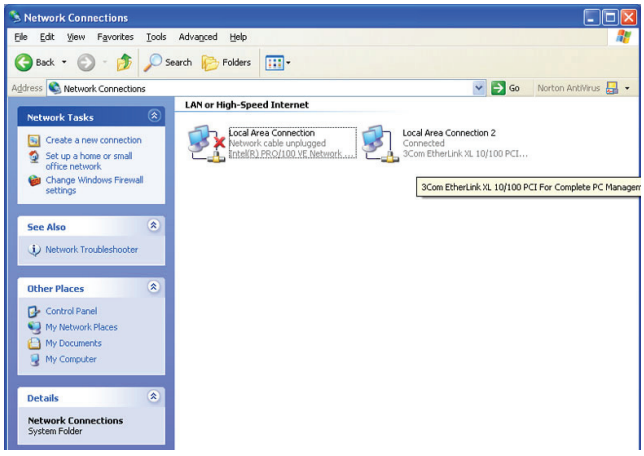


Figure 2.1-5, Configure Network Connection Screen

2.2 DISABLE VIRUS AND FIREWALL SOFTWARE

There have been reports of virus checking software adversely affecting performance and sometimes even causing errors in the Spectro-FTIR Alpha Alpha software. It has been established that virus checking software can slow down performance in certain situations. We recommend that virus checking software be configured in such a way as to minimize the effects of virus scanner interference.

Some virus checking software systems have the ability to virus scan continuously in the background. This type of configuration can slow down the performance of software, particularly in a network environment.

The Spectro-FTIR Alpha Alpha software is data processing software that is very disk I/O intensive. The software is constantly opening files, writing to them and closing them. The software also makes frequent use of temporary files. For these reasons, the potential performance decrease caused by continuous virus scanning may be more apparent in our software than in some other types of applications.

The Spectro-FTIR Alpha Alpha software uses a network interface for communication. This communication cannot be run through a firewall protection system. The delays caused by the firewall can severely interrupt the analysis process and cause system errors. The network adapter that communicates with the FTIR should be disabled in any firewall software and in Windows XP Firewall.

2.2.1 Excluding Spectro-FTIR Alpha Alpha Software Program Directory from Continuous Virus Checking

This section details the step-by-step procedures to disable virus checking software from different manufacturers to exclude specific Spectro-FTIR Alpha Alpha software files.

2.2.1.1 Symantec Norton AntiVirus Corporate Edition

Use the following procedure for configuring Symantec Norton AntiVirus Corporate Edition on a workstation to exclude the WIBUKEY, WIBU-SYSTEMS, and OPUS program directories from continuous virus scanning:

1. Select ***Start*** | ***Programs*** | ***Symantec Client Security*** | ***Symantec AntiVirus Client***.
2. Select ***Configure*** | ***File System Realtime Protection***.
3. In the **Options** section, select the **Exclude selected files and folders** check box.
4. Click **Exclusions**.
5. Select the **Check file for exclusion before scanning** check box.
6. Click **Files/Folders**.
7. Browse to the WIBUKEY software program directory (for example, C:\Program Files\WIBUKEY) and select the corresponding check box.
8. Browse to the WIBU-SYSTEMS software program directory (for example, C:\Program Files\ WIBU-SYSTEMS) and select the corresponding check box.
9. Browse to the OPUS software program directory (for example, C:\Program Files\ OPUS) and select the corresponding check box.
10. Click **OK** three times to save your changes.
11. Click **Exit** to exit Symantec AntiVirus Corporate Edition.

NOTE: Additional instructions regarding how to exclude files and directories can be found on Symantec's Knowledge Base on the Internet.

2.2.1.2 Symantec Norton AntiVirus Consumer Edition

Use the following procedure for configuring Symantec Norton AntiVirus Consumer Edition on a workstation to exclude the WIBUKEY, WIBU-SYSTEMS, and OPUS program directory from continuous virus scanning:

1. Open Norton and click **Options**.
2. Select **Autoprotect** | then **Exclusions**.
3. Click **New** and type in the path of the WIBUKEY directory (for example C:\Program Files\ WIBUKEY), make sure to include subfolders.
4. Click **New** and type in the path of the WIBU-SYSTEMS directory (for example C:\Program Files\ WIBU-SYSTEMS), make sure to include subfolders.
5. Click **New** and type in the path of the OPUS directory (for example C:\Program Files\ OPUS), make sure to include subfolders.
6. Click **OK** and then **Exit**.

NO*TE: Additional instructions regarding how*

to exclude files and directories for your specific version of the consumer edition can be found on Symantec's Knowledge Base on the Internet at: http://service1.symantec.com/SUPPORT/nav.nsf/pfdocs/199829164436

2.2.1.3 McAfee VirusScan

Use the following procedure for configuring McAfee VirusScan Enterprise to exclude the WIBUKEY, WIBU-SYSTEMS, and OPUS program directory from continuous virus scanning:

1. Open the **On-Access Scan Properties** dialog box, then select one of the following icons in the left-hand pane:
   - **Default Processes**
   - **Low-Risk Processes**
   - **High-Risk Processes**
2. On the **Detection** tab, click **Exclusions** in the What Not to Scan area. This will open the 3. Set Exclusions dialog box.
   The Set Exclusions dialog box lets you add or edit files, folders, or drives. Windows File Protection is listed by default.
   - **To add an item to the list of exclusions, open the Add Exclusion Items dialog box by clicking Add.**
   - **To edit an item in the list, you can double-click it or select it and then click Edit.**

For more information on file exclusions in McAfee software, see the user's guide provided with the McAfee software, or see McAfee's Web site at http://www.McAfee.com.

2.2.2 Disabling Firewall Software

This section details the step-by-step procedures to disable firewall software from different manufacturers to exclude the Spectro-FTIR.

2.2.2.1 Disable Internet Connection Firewall in Windows XP or Windows XP SP1

A firewall is designed to help protect your computer from attack by malicious users or by malicious software. Malicious software includes viruses that use unsolicited incoming network traffic to attack your computer. Before you disable your firewall, you must disconnect your computer from all networks, including the Internet. To do this, follow these steps:

1. In Control Panel, double-click Networking and Internet Connections, and then click Network Connections.
2. Right-click the connection on which you want to disable ICF, and then click Properties.
3. On the Advanced tab, click to clear the Protect my computer or network check box.

2.2.2.2 Disable Windows Firewall in Windows XP SP2

A firewall is designed to help protect your computer from attack by malicious users or by malicious software. Malicious software includes viruses that use unsolicited incoming network traffic to attack your computer. Before you disable your firewall, you must disconnect your computer from all networks, including the Internet. To do this, follow these steps:

1. Click Start, click Run, type Firewall.cpl, and then click OK.
2. On the General tab, click Off (not recommended), and then click OK.

2.2.2.3 Norton Internet Security

1. Log on using an account with Adult or Supervisor rights. Open Norton Internet Security.
2. On the left side of the window, click **Internet Status** and then click **Current Status**.
3. In the Current Status window, click **Disable**.

2.2.2.4 Norton Personal Firewall

1. Open Norton Personal Fireall.
2. On the left side of the window, click **Internet Status** and then click **Current Status**.
3. In the Current Status window, click **Disable**.

You can also disable Norton Personal Firewall by right-clicking on the Norton Personal Firewall icon in the notification area of the taskbar and selecting disable.

2.2.2.5 McAfee Internet Security

1. Right-click the McAfee icon.
2. Point to **Personal Firewall** and then click **Options**.
3. Click the **Security** tab.
4. Set the Security Level by moving the slider to the desired level.
5. Set **Access** to **Low**.
6. Click **OK** to save changes.

2.2.2.6 McAfee Firewall

1. Click **Stop McAfee Firewall** to disable the

software.
2. From the **Welcome to McAfee Firewall** screen, go to the **Network Control Settings** and select **Allow All Traffic**.

2.3 OPUS SOFTWARE INSTALLATION AND CUSTOMIZATION

The OPUS software is supplied with your Spectro-FTIR Alpha on a CD-ROM. If the PC was purchased with the Spectro-FTIR Alpha the OPUS software will be pre-installed by Spectro Inc.

2.3.1 Installing OPUS Software

The following is the procedure to install the OPUS software when the customer supplies the PC, or if it needs to be re-installed for maintenance purposes or onto a new computer.

1. Locate the OPUS CD-ROM that is supplied in the plastic box supplied with the Spectro-FTIR, Figure 2.3-1. Open the box and install the CD-ROM into the PC.

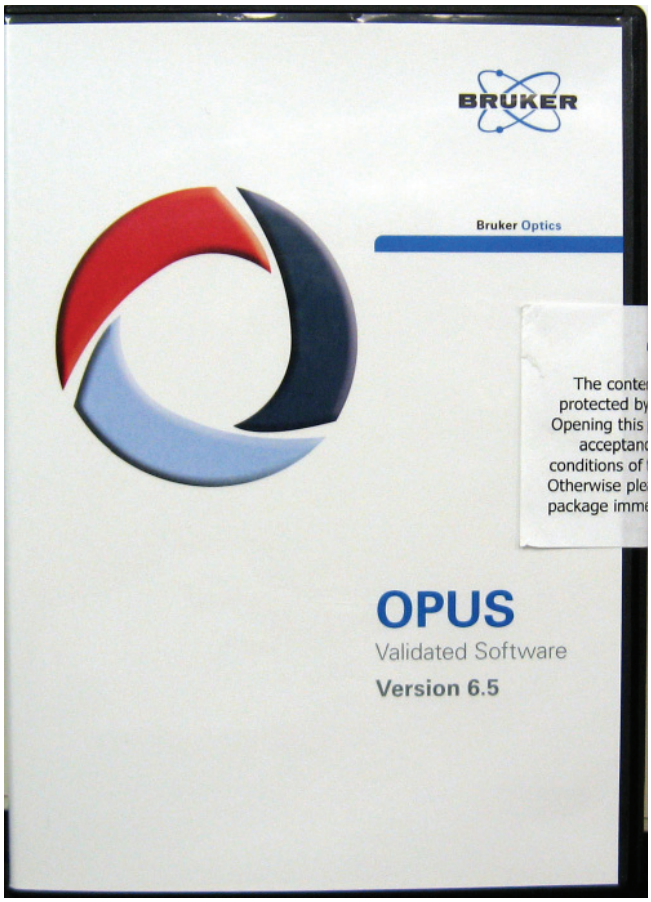


Figure 2.3-1, OPUS CD-ROM Software Box

2. The OPUS InstallShield Wizard opens in auto-start and the first screens asks you to select your language preference. Select a language from the drop-down menu and click on "**OK**".

3. The next screen does not apply to the Spectro-FTIR, Figure 2.3-2. Leave the box unchecked. Click on the "**Next**" button.

4. On the License Agreement screen, Figureure 2.3-3, select the radio button for "**I accept the terms of the license agreement**". Click on the "**Next**" button.

5. The next screen requires that the "**User Name**" and "**Company**" name be entered, Figure 2.3-4. The information entered is up to the user. Select whether the application is to be installed for any user of the PC, or just an individual. Click on the "Next" button.
6. The next screen allows you to select the

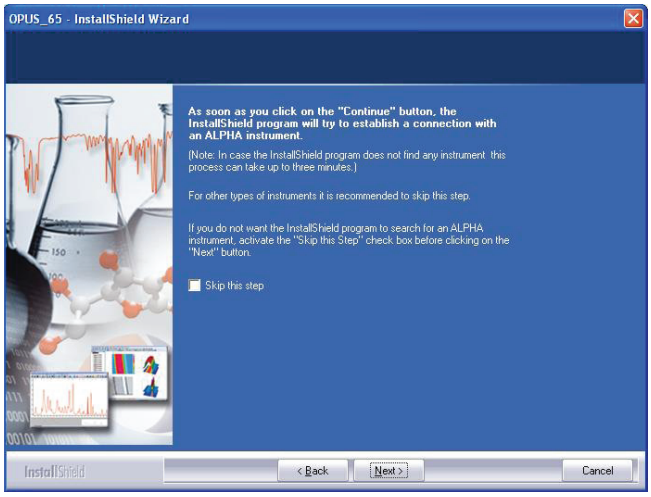


Figure 2.3-2, Skip this Step

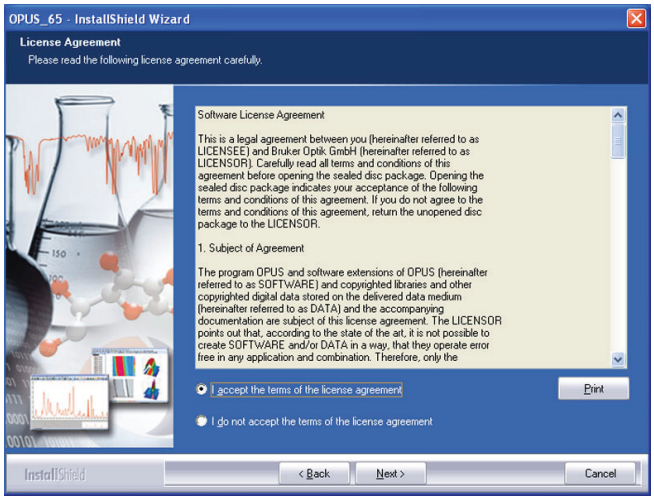


Figure 2.3-3, License Agreement

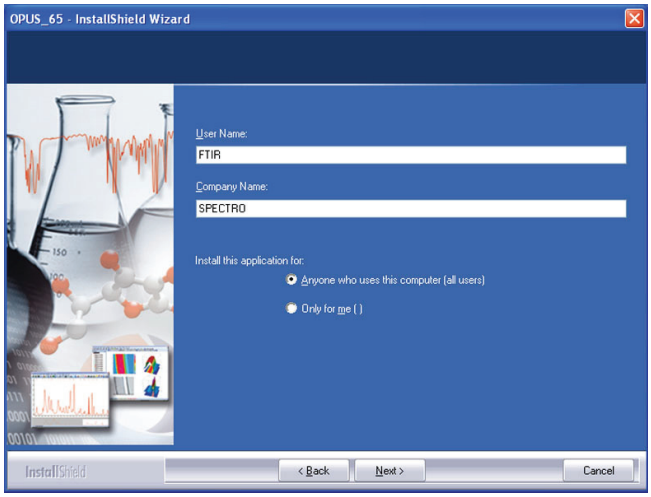


Figure 2.3-4, User name and Company Screen

destination on your computer where you wish to install the OPUS files, Figure 2.3-5. The default is the Program Files folder. Click on the "**Next**" button to select the default location, or select the "Browse" button to change the location.

7. The next screen, Figure 2.3-6 allows you to import instrument configurations if OPUS was previously installed on this PC. On new installations, select the radio button for "**No, skip this step**" and click on the "**Next**" button.

8. The final screen in the sequence, Figure 2.3-7 allows you to go back to review or change any of the installations settings, or if you are ready, click on "Install" to begin the installation process.

9. When the installation is complete, the installation protocol can be printed by selecting "**Print**", or by selecting "**Accept**". A link to the OPUS software will be placed on the PC's desk-

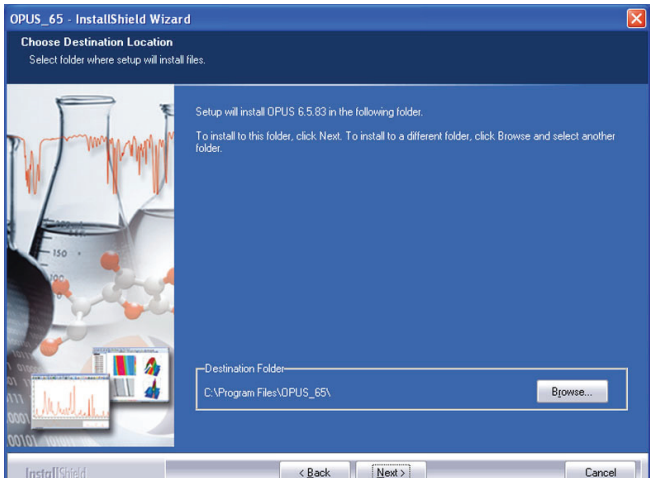


Figure 2.3-5, Install Destination Screen

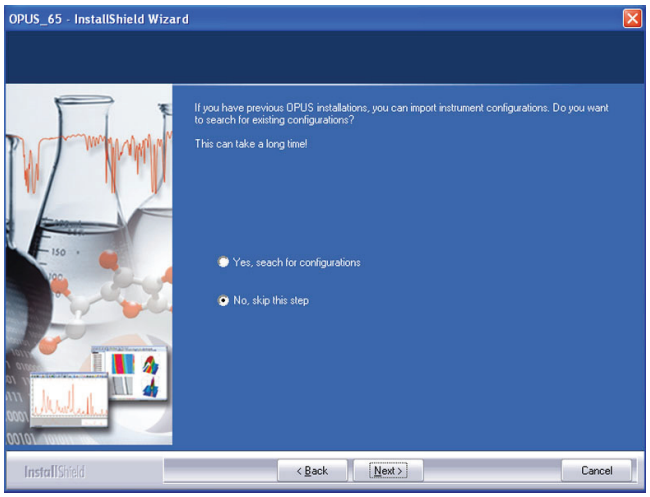


Figure 2.3-6, Import from Previous Installation Screen

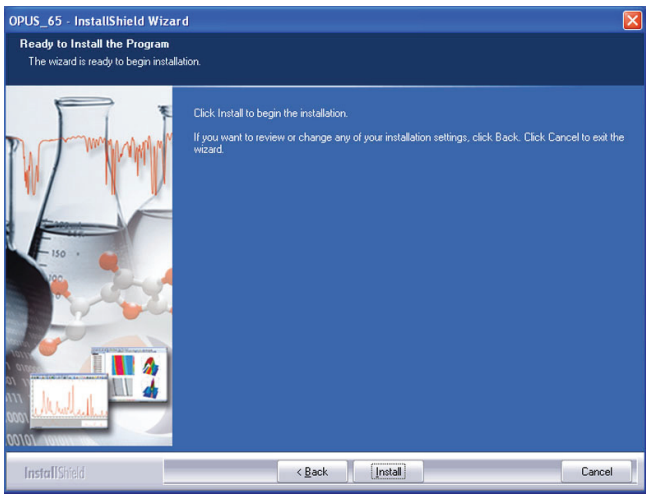


Figure 2.3-7, Ready to Install OPUS Screen

top

10. When the OPUS software installation procedure is complete, the screen shown in Figure 2.3-8 appears. Select the check box for "**I want to start OPUS"** and click on "**Finish**".

11. When the OPUS software opens, the OPUS Login screen appears, Figure 2.3-9, and a password must be entered. The User ID is "**Default**" and the Password is "**OPUS**" (all capital letters, no quotation marks). Click on "**Login**" to start the software.

11. The About OPUS screen appears, Figure 2.3-10 Click on the "**OK**" button and the screen will disappear.

9. This completes the OPUS software installation procedure.

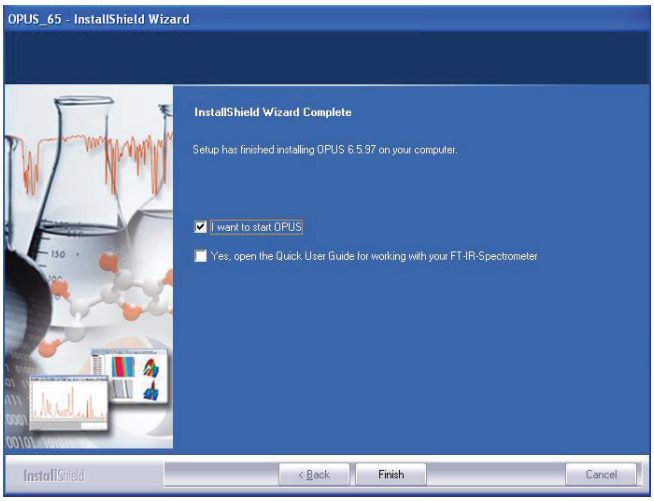


Figure 2.3-8, Start OPUS Screen

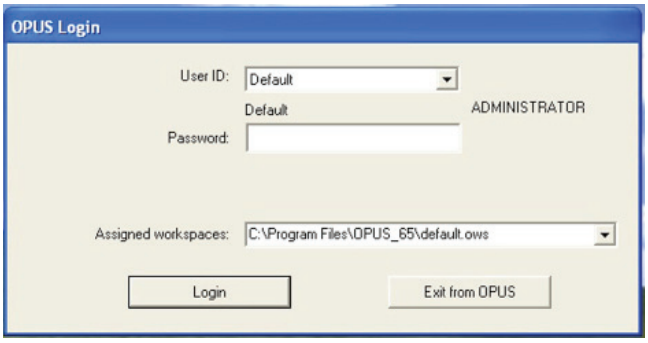


Figure 2.3-9, OPUS Login Screen

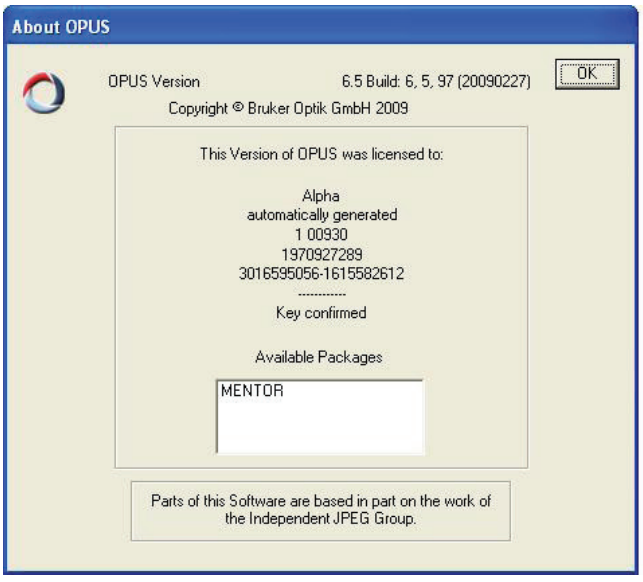


Figure 2.3-10, About OPUS Screen

NOTE: The PQ test will run automatically during the first time OPUS is setup as indicated by the status bar. This will not be the case when the Spectro Oil Analysis Software is installed.

2.3.2 Customize Measure Drop-Down Menu

Depending on the version of the OPUS software, the Measure drop-down menu may already be configured as necessary with the commands for use with the Spectro-FTIR Alpha Alpha Alpha Oil Analysis Software. This procedure will show the user the commands that are required and if they are not present, how to install them.

1. If not already open, load the OPUS software, by double clicking on its desktop icon.

2. When the OPUS software opens, the OPUS Login screen appears and a password must be entered. The User ID is "**Default**" and the Password is "**OPUS**" (all capital letters, no quotation marks). Click on "**Login**" to start the software.

3. From the OPUS Operator Default screen click on the "**Measure**" menu bar drop-down menu, Figure 2.3-11. The two commands that must be available and installed are "**Advanced Measurement**" and "**Optic Setup and Service**". Verify that the commands are installed, if they are, customization is not necessary, proceed with Step 8. If one or both of the commands are not present, proceed with Step 4.

4. To customize the Measure drop-down menu, select the "**View**" drop-down menu and select the "**Toolbars**" command, Figure 2.3-12.

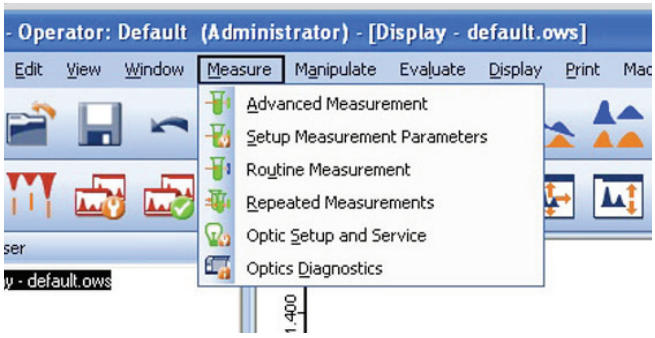


Figure 2.3-11, Measure Drop-down Menu

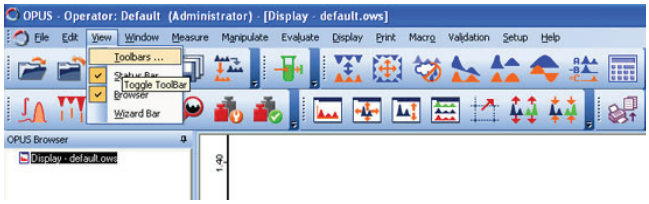


Figure 2.3-12, Select Toolbars Command

5. The Customization screen appears, Figure 2.3-13. Make sure that the "**Commands**" tab is selected. Select "**Measure**" in the Customization menu Categories column by clicking on it.

6. Locate "**Advanced Measurement**" in the commands column and select it by clicking and holding the mouse button, Figure 2.3-14. While holding down the mouse button drag the "**Advanced Measurement**" command to the "**Measure**" drop-down menu. The Measure drop-down menu will open and the command can be dropped at any preferred location in the drop-down sequence. Note that a horizontal bar signifies where command is being located in the sequence. Release the mouse button to place the command into the Measure drop down menu.

7. Repeat Step 6 but this time for the "**Optic Setup and Service**" command. Click on "**Close**" in the Customization menu to finish the Measure drop-down menu customization.

8. Click on the "**Measure**" drop-down menu and select "**Optic Setup and Service**" command, Figure 2.3-15.

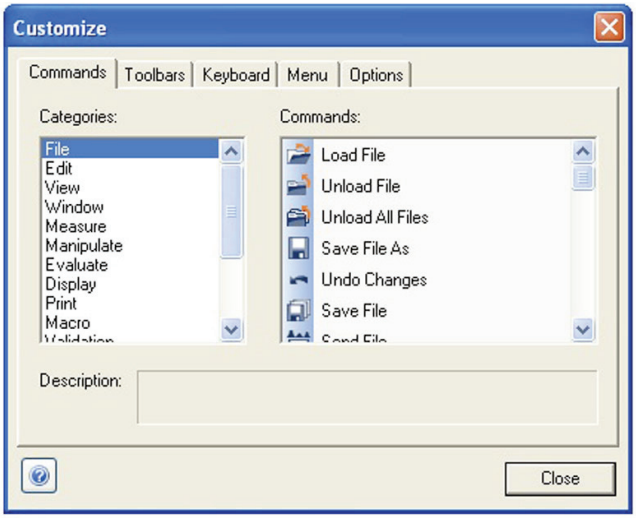


Figure 2.3-13, Diagnostic Test Status Indicator

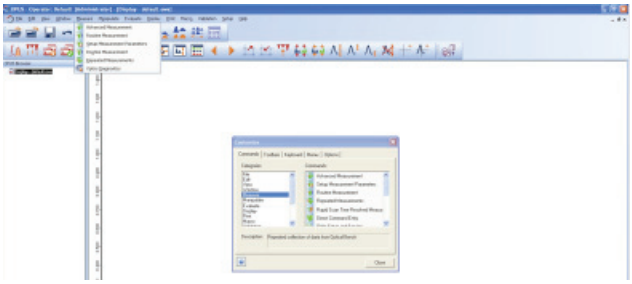


Figure 2.3-14, Drag and Drop Commands to Menues

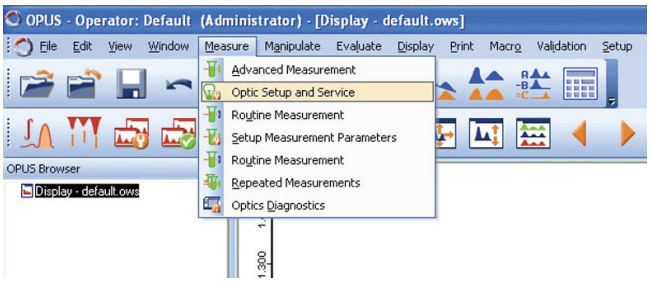


Figure 2.3-15, Select Optic Setup and Service

9 The Optic Setup and Service menu appears. Select the "**Devices/Options**" tab, Figure 2.3-16. Verify that "**Enforce Predefined Measurement Parameters**" and "**Automatic Accessory Recognition**" are not selected with a "√" mark. If one or both are selected, de-select them by clicking on the check box.

10. Click on the "**Save Settings**" button to complete the Measure menu customization procedure.

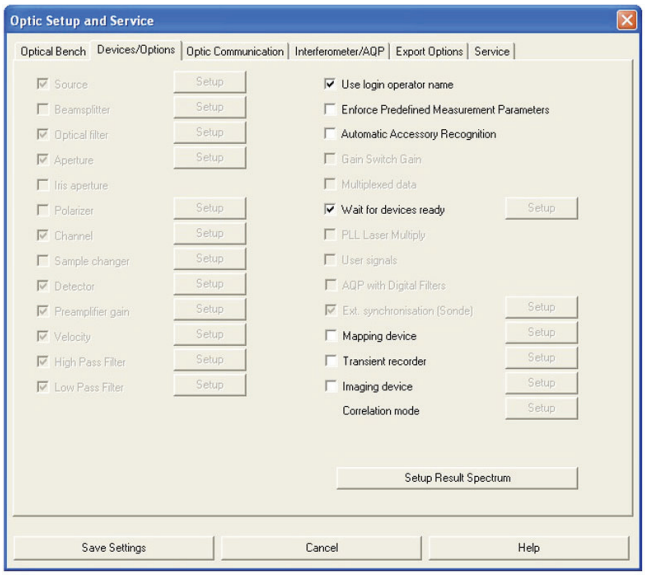


Figure 2.3-16, Optic Setup and Service Screen

2.3.3 Disable FDA Compliance

The Spectro-FTIR Alpha Alpha OPUS software defaults to Food and Drug Administration (FDA) specification 21 CFR 11 for pharmaceutical and biotechnology industries. This specification does not apply to oil analysis and it must be disabled in order to analyze lubricants.

1. If not already open, load the OPUS software, by double clicking on its desktop icon.

2. When the OPUS software opens, the OPUS Login screen appears and a password must be entered. The User ID is "Default" and the Password is "OPUS" (all capital letters, no quotation marks). Click on "**Login**" to start the software.

3. From the OPUS Operator Default screen click on the "**Setup**" menu bar drop-down menu and select "**User Settings**", Figure 2.3-17.

4. The window for User Settings shown in figure 2.3-18 appears. Click on the "**CFR11**" tab to select it. In the lower section, "**Validation options**", deselect "**Work in GLP mode (Save original data)**" so that there is no check mark to the left of it.

5. Click on "**OK**" to complete this procedure to disable FDA data maintenance requirements.

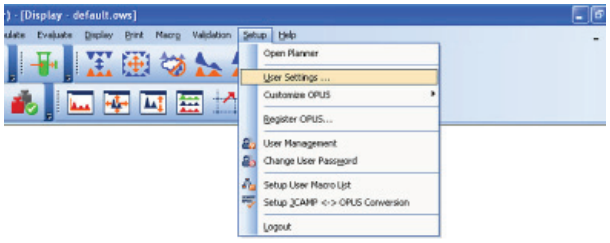


Figure 2.3-17, Select User Setting

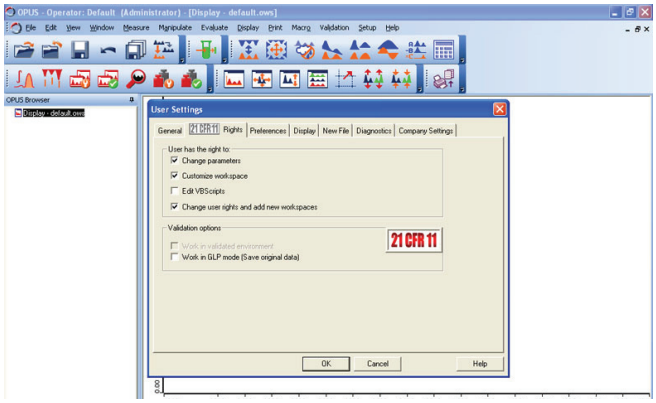


Figure 2.3-18, Deselect Work in GLP Mode

2.4 INSTALL SPECTRO-FTIR OIL ANALYSIS SOFTWARE

This section details the step-by-step procedure to install the Spectro FTIR Oil Analysis Software. The Spectro FTIR Oil Analysis Software is delivered with your instrument on a CD-ROM.

NOTE: Exit the OPUS software before installing the Spectro FTIR Oil Analysis Software.

To install the software:

1. Locate the Spectro-FTIR Alpha Oil Analysis Software CD-ROM and insert it into the PC.

2. Locate the CD-ROM on the PC by opening "**My Computer**". The icon for the Spectro-FTIR Alpha Oil Analysis Software CD-ROM will be listed under the "**Devices and Removable Storage**" section. Double click on the Spectro-FTIR Alpha Oil Analysis Software icon to open it.

3. The Spectro-FTIR Alpha Oil Analysis Software CD-ROM contains three types of files, Acrobat Reader, Manuals in PDF format, and the installation program. Double click on the "**Installation**" icon.

NOTE: ***Acrobat Reader must be installed on the computer in order print the PQ test report which is created in the PDF format.***

4. The screen shown in Figure 2.4-1 will instruct you to close all open files. Click on "**Next**" to

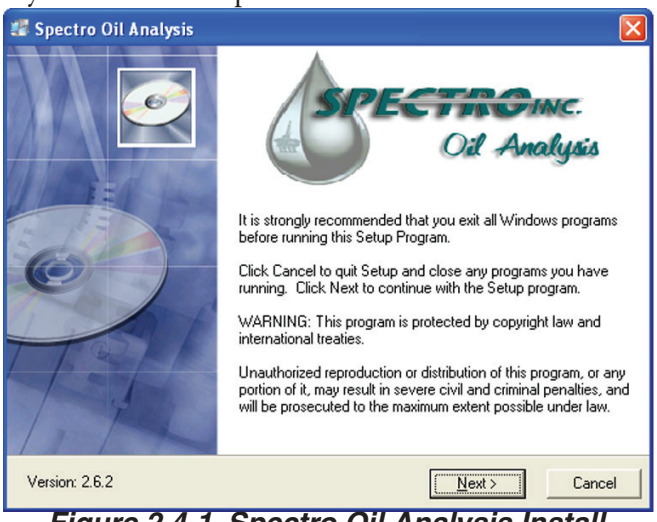


Figure 2.4-1, Spectro Oil Analysis Install Screen

proceed.

5. The next screen, Figure 2.4-2 has a ReadMe file. Read the file for any last minute instructions. Click on "**Next**" to proceed.

6. The next screen allows you to select the destination on your computer where you wish to install the Spectro FTIR Oil Analysis Software, Figure 2.4-3. The default is the Program Files folder. Click on the "**Next**" button to select the default location, or select the "Browse" button to change the location.

7. The next screen is to select the type of instrument used for the Oil Analysis Software, Figure 2.4-4. The same software can be installed on the Spectro-FTIR Alpha or the Spectro-FTIR Alpha Alpha. Select "**Alpha**" and click the "**Next**" button to proceed.

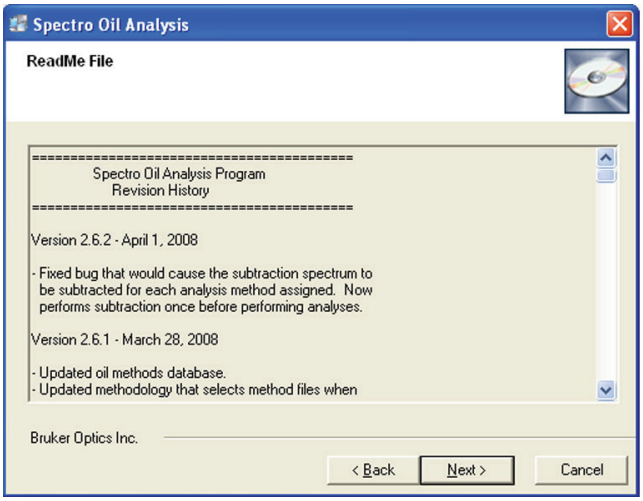


Figure 2.4-2, Read Me File

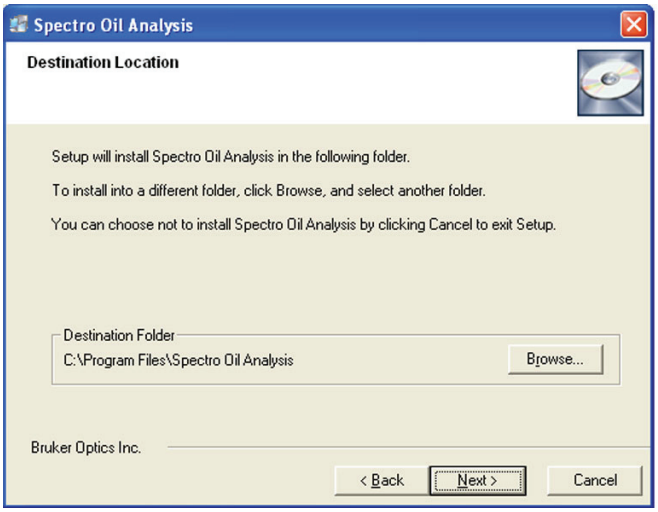


Figure 2.4-3, Select Install Destination

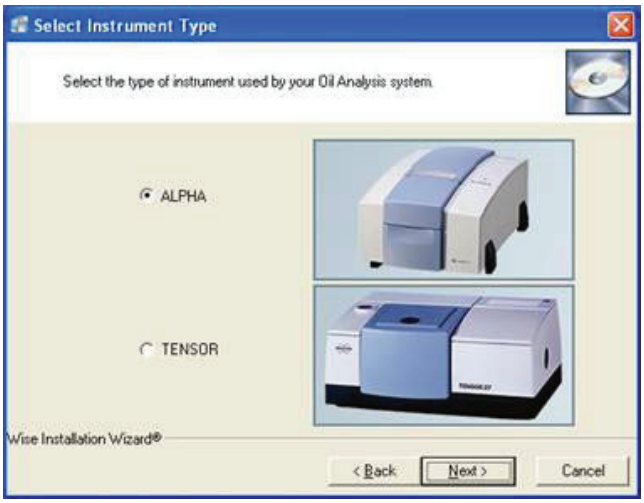


Figure 2.4-4, Select the Instrument Screen

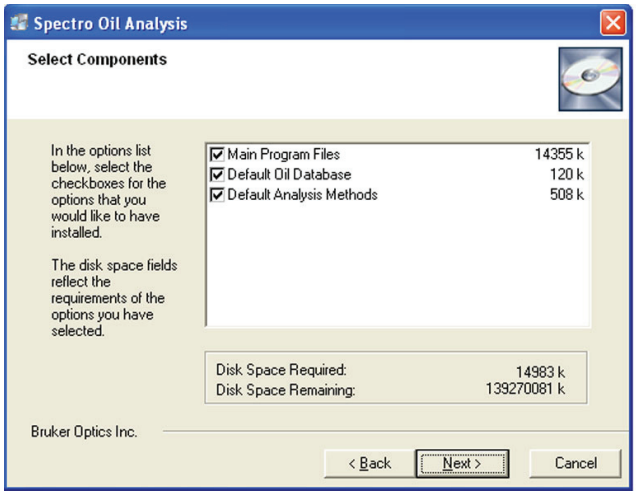


Figure 2.4-5, Files to be Installed

8. The next screen, Figure 2.4-5, lists the files to be installed. All three files, (Main Program Files, Default Oil Database, Default Analysis Methods) should already be selected. If not, select them and click on "**Next**" to proceed.

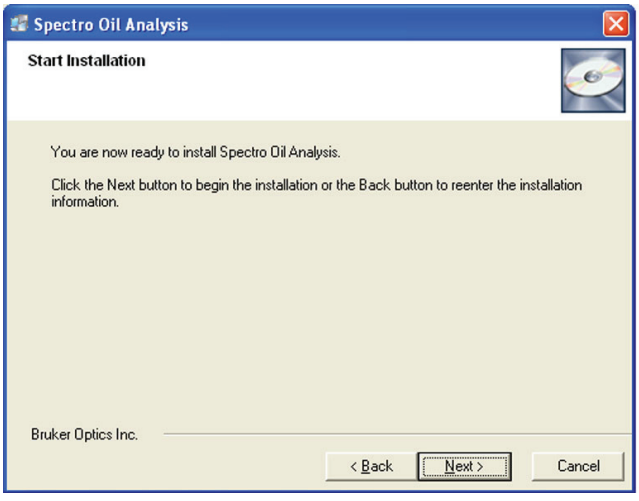


Figure 2.4-6, Start Installation Screen

9. The Start Installation screen, Figure 2.4-6 provides an option to go back and make changes, or to proceed with the installation. Click "**Next**" to install the Spectro-FTIR Alpha Oil Analysis Software.

10. When the software has been installed successfully, the screen, Figure 2.4-7, appears to confirm the installation. Click on "**Finish**" to exit the Spectro-FTIR Alpha Oil Analysis Software installation.

11. This completes the Spectro-FTIR Alpha Oil Analysis Software Installation.

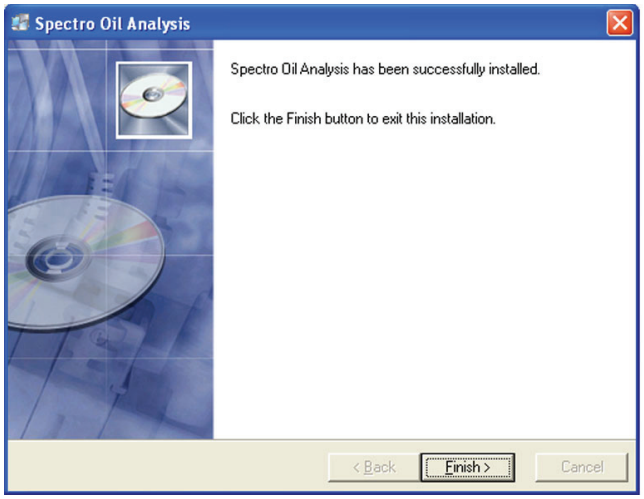


Figure 2.4-7, Software Successfully Installed Screen

2.5 QUICK START DIAGNOSTIC TEST INSTRUCTION GUIDE

The following steps assume that prior communication between the Spectro-FTIR Alpha and the PC has been established. See Chapter 1 of this manual for steps on how to establish communication using TCP/IP.

1. Turn the Alpha on by plugging in the power cable at the back and connecting the crossover communication cable. You should see a yellowish/ green light and hear an audible beep as the connection is being made with the PC.

2. Start the Spectro Oil Analysis Software, the OPUS software will flash up briefly and be loaded in the background. You should hear two audible beeps from the Alpha.

3. When the unit is plugged in and turned on for the first time the source in the Alpha will need to warm up for 7-10 minutes. You may see a warning message in the bottom right corner warning you of this. Click on the **Diagnosis** button, Figure 2.5-1

4. The instrument status diagnostic screen, Figure 2.5-2 will appear. Note that in this screen shot the diagnostic test has also expired. This may or may not have expired when you turn the unit on depending when it was last run. The diagnostic PQ test is required to run every 7 days.

NOTE: The PQ test will run automatically during the first time OPUS is setup as indicated by the status bar. This will not be the case when the Spectro Oil Analysis Software is installed.

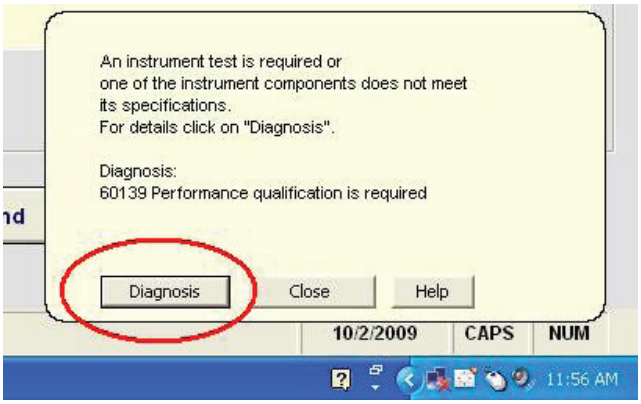


Figure 2.5-1, Diagnosis Screen

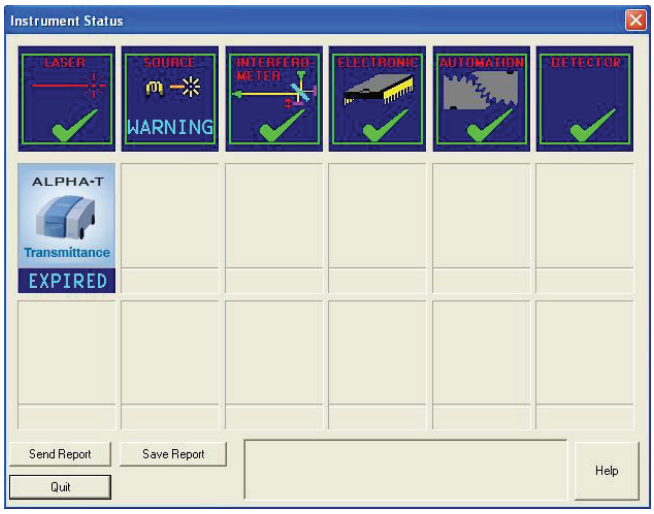


Figure 2.5-2, Status Diagnostic Screen

5. After about 7 -10 minutes the warning message in the source box should disappear and you will see a green check mark. You should also notice that the green light on top of the Alpha will change to a brighter green when all the hardware components pass self check.

6. If the Alpha check box shows "expired", a PQ test will have to be performed before it is possible to analyze samples with the Spectro Oil Analysis macro. Remove the flip-top cell from the sample chamber.

NOTE: The PQ must be performed with the flip-top cell removed. The unit will not pass the test with the cell installed.

7. Click the "**expired**" box and the PQ test screen will appear, Figure 2.5-3. Press the **Run Tests** button to begin the tests. A message stating that the test is in process will appear, Figure 2.5-4.

NOTE: make sure that the source has warmed up and shows a tick mark in the check box before running a PQ test.

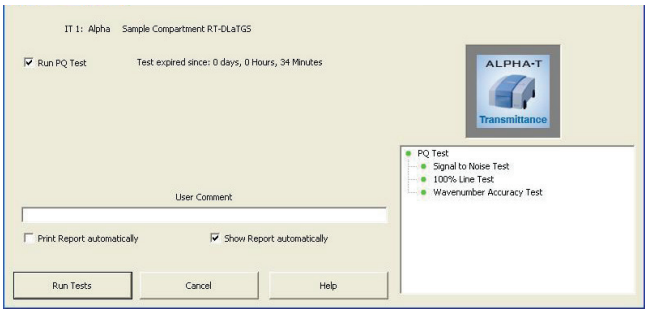


Figure 2.5-3, PQ Test Screen

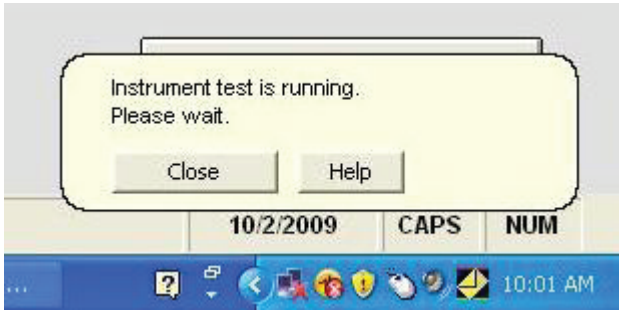


Figure 2.5-4, Test in Process

8. After the tests are complete, an OVP results report is displayed and logged, Figure 2.5-5.

9. If the PQ test was successful, the diagnostic screen shown in Figure 2.5-6 will appear the following diagnostic screen should appear.

NOTE: You can also obtain this diagnostic screen at any time by pressing the circular button in the bottom

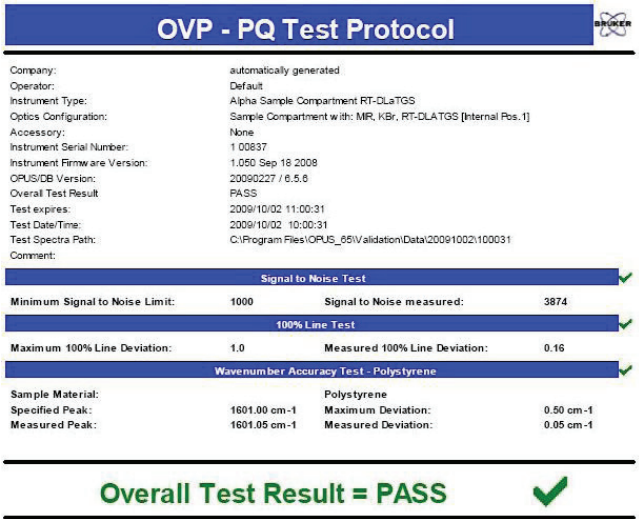


Figure 2.5-5, PQ Test Protocol

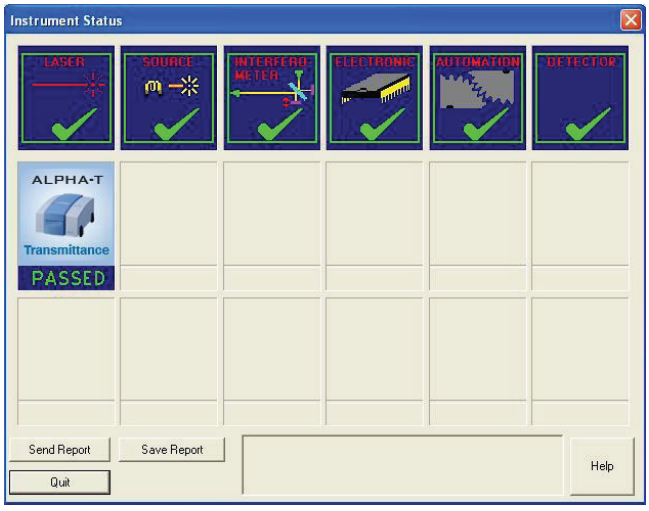


Figure 2.5-6, All Tests Successful

of the opus software – it could be yellow or red if there is a warning or error somewhere in the system, Figure 2.5-7.

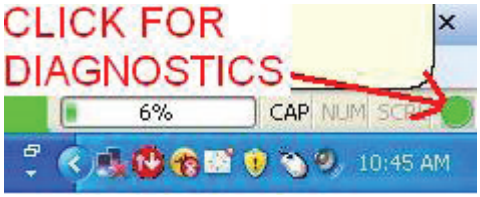


Figure 2.5-7, Diagnostic Test Status Indicator

2.6 SET CELL PATH LENGTH AND INSTALLATION OF THE FLIP-TOP CELL

The Spectro-FTIR Alpha is tested at Spectro Inc. with the flip-top installed, however the cell is removed for shipment. This sections describes how to to verify the cell path length entry in the Spectro Oil Analysis Software and how to install the cell in the spectrometer..

2.6.1 Set or verify the flip-Top Cell Path Length

The path length of the cell delivered with the Spectro-FTIR Alpha is entered at the factory, however, it is always good practice to verify the setting in case the cell was changed prior to delivery. To set or verify the flip-top cell path length into the Spectro Oil Analysis Software:

1. Locate the flip-top cell and make note of its path length. The path length of the cell is its inside dimension between its two windows. The dimension of the cell path length is approximately 100 micrometers, and the actual measured dimension is printed on the cell.

2. Start the Spectro Oil Analysis Software by either double-clicking on the "**Spectro Oil Analysis**" icon on the PC desktop, or by selecting it from the "**Programs**" section of the "**START**" menu.

3. The Main Spectro FTIR Oil Analysis screen will appear. Select "**Setup**" and from its drop-down menu, select "**Program Options**", Figure 2.6-1.

4. The Program Setup screen, Figure 2.6-2 appears. The tab for "**Options 1**" should be the default tab, if not select it by clicking on its tab.

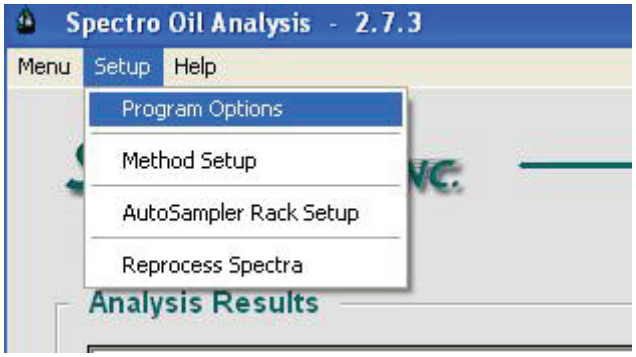


Figure 2.6-1, Setup Drop-down Menu

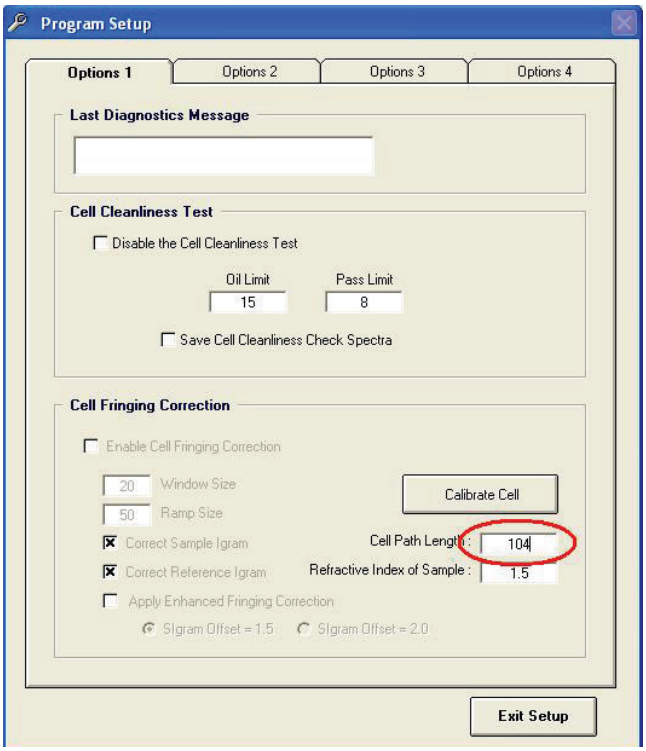


Figure 2.6-2, Enter Cell Path Length Printed on Cell

5. The cell path length is entered into the Cell Path Length field in the lower right hand corner of the tab. Enter the value provided with your cell if it is different from the one already entered. In the example, the path length is 104 micrometers.

6. Click on "**Exit Setup**" to complete the task.

2.6.2 Install the Flip-Top Cell

The flip-top cell holds the sample for analysis by the Spectro-FTIR Alpha. The cell is mounted in a holder and can be installed or removed by sliding it in or out.

To install the flip-top cell:

1. Raise the sample compartment lid to gain access to the sample compartment.

2. Grasp the flip-top cell assembly and carefully slide it down into its holder, Figure 2.6-3.

3. When installed, push again on the top of the cell to verify that it is seated all the way to the bottom of the holder.

4. Close the sample compartment lid by lowering it into the closed position.



Figure 2.6-3, Install Flip-Top Cell Assembly

5. The Spectro-FTIR Alpha is now ready to analyze samples.

2.7 SET BACKGROUND MEASUREMENT INTERVAL

The background measurement is an analysis performed with the Spectro-FTIR Alpha while the flip-top cell does not contain a sample. In other words, it is the spectrum generated from the components in the optical path that are not associated with an oil sample. When an oil sample is analyzed, the background is subtracted resulting in improved accuracy.

The current background spectrum is lost when the instrument is turned OFF, or if more than a user selected time has elapsed. The user must always record a background spectrum prior to collecting the first measurement after turning the instrument on.

Assuming the background spectrum doesn't change, the same background spectrum can be applied to any sample measurement. However, in order to help ensure that the background spectrum is current, the user is required to record a new background spectrum every so often.

The recommended background test interval setting for the Spectro-FTIR Alpha is one hour. This assures sufficient accuracy to get started, however the interval can be changed with experience if environmental conditions are relatively constant. It is also good practice and recommended that the interval

must never exceed 24 hours.

To set the background measurement interval:

1. Start the Spectro Oil Analysis Software by either double-clicking on the "**Spectro Oil Analysis**" icon on the PC desktop, or by selecting it from the "**Programs**" section of the "**START**" menu.

2. The Main Spectro FTIR Oil Analysis screen will appear. Select "**Setup**" and from its drop-down menu, select "**Program Options**", Figure 2.6-1.

3. The Program Setup screen, Figure 2.6-2 appears. The tab for "**Options 1**" should be the default tab.

4. Click on the "**Option 3**" tab to select it, Figure 2.7-1.

5. In the top options setting, select "**Force New Background**" and enter "1" in the hours field.

6. Click on "**Exit Setup**" to complete the task.

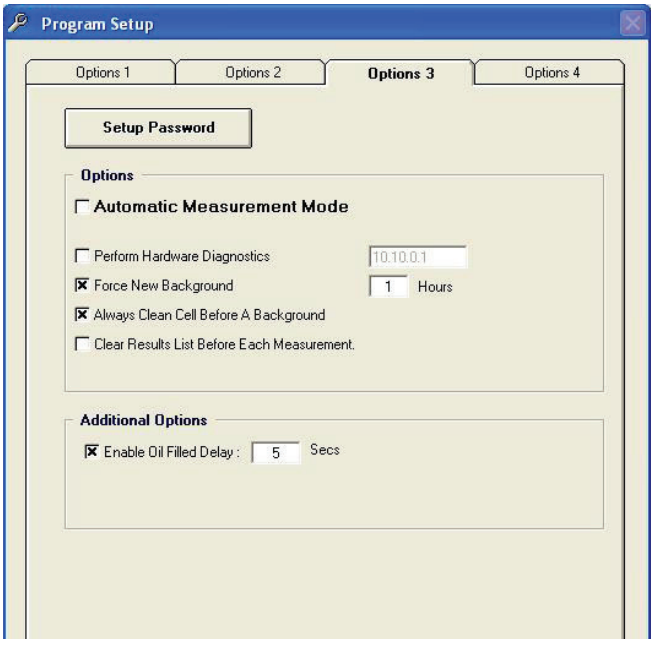


Figure 2.7-1, Enter Background Measurment Interval

Chapter 3

Routine Sample Analysis

3.0 ROUTINE SAMPLE ANALYSIS

This chapter describes the routine operating procedures for the Spectro-FTIR Alpha in the analysis of in service oil samples. The Spectro-FTIR Alpha is delivered with multiple analysis programs, and it can also be used to trend lubricant degradation and contamination based on ASTM Standard Practice E 2412. One copy is supplied with your Spectro-FTIR.

NOTE: Additional copies of ASTM E 2412 Standard Practice for Condition Monitoring of Used Lubricants by Trend Analysis Using Fourier Transform Infrared (FT-IR) Spectrometry are available from ASTM International at: http://www.astm.org.

3.1 INTRODUCTION

The Spectro-FTIR Alpha Oil Analysis program is used to measure and analyze oil degradation and contamination. Routine sample analysis consists of Daily Diagnostic Tests and Sample Analysis, either manually or automatically with an AutoSampler.

The Spectro-FTIR Alpha user interface is simple and easy to operate. In manual operation mode, the operator selects the type of oil to analyze from a list and presses a single on-screen button to begin analysis. An on-screen wizard walks the operator through the task of filling and cleaning the cell. An automatic cleanliness check is performed on the sample cell prior to any measurement to ensure there is no contamination present from previous measurements. The results of each measurement are displayed to the user, and optionally saved to a file for further analysis and study. An optional computer controlled AutoSampler and pump can be used to automatically sample and analyze an entire rack of samples.

This chapter assumes that several on-time procedures have already been performed, they are:

- The OPUS software has been installed and tested, Section 2.3.
- The Spectro-FTIR Alpha Oil Analysis program has been installed, Section 2.4.
- Measurement analysis operating options have been setup, Section 2.5.
- The cell path length has been verified and the cll has been installed, Section 2.7.

3.2 QUICK START ROUTINE

The following steps assume that prior communication between the Spectro-FTIR Alpha and the PC has been established. See Chapter 1 of this manual for steps on how to establish communication using TCP/IP.

This routine must be performed when the Spectro-FTIR Alpha is first setup and every 7 days thereafter. However, if the power has been removed from the unit, the procedure must also be performed.

The software will notify the user if a test has to be performed by providing a warning message with instructions.

1. Start the Spectro Oil Analysis Software, the OPUS software will flash up briefly and be loaded in the background. You should hear two audible beeps from the Alpha. When the unit is plugged in and turned on for the first time the source in the Alpha will need to warm up for 7-10 minutes.

2. If any of the diagnosis tests have expired, a warning message will appear in the bottom right corner of the screen, Figure 3.2-1. If the message appears, proceed with step 3. If the warning message does not appear, the tests are up to date and you can proceed with the analysis of samples, Sections 3.3 and 3.4.

3. Click on the "**Diagnosis"** button, Figure 3.2-1

4. The instrument status diagnostic screen, Figure 3.2-2 will appear. Note that in this screen example, the diagnostic test has also expired. This may or may not have expired when you turn the unit on depending when it was last run. The diagnostic PQ test is required to run every 7 days. The Spectro Oil Analysis Software will not run unless this has passed.

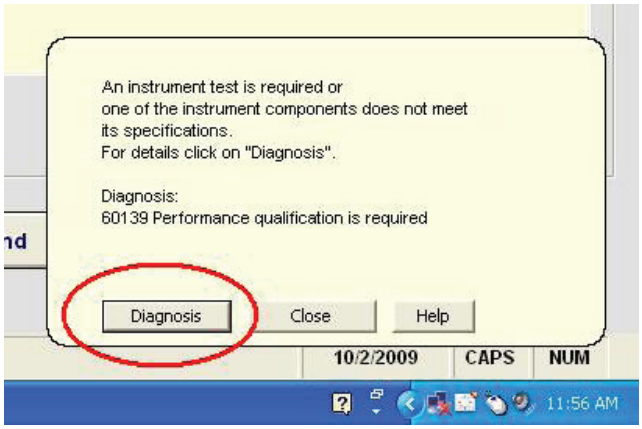


Figure 3.2-1, Diagnosis Screen

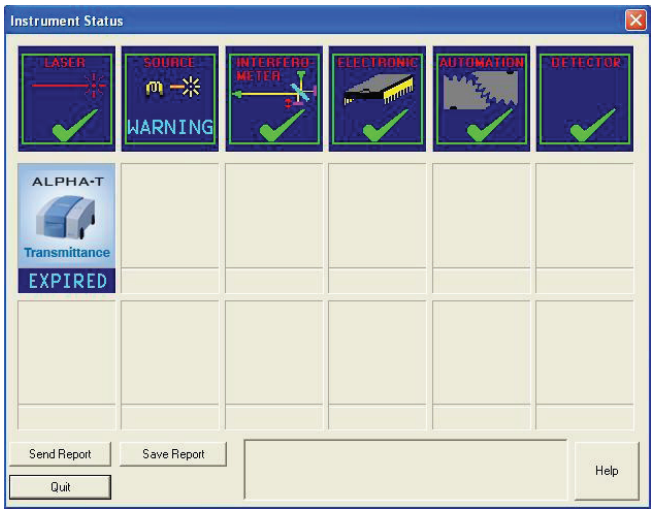


Figure 3.2-2, Status Diagnostic Screen

5. After about 7 -10 minutes the warning message in the source box should disappear and you will see a green check mark. You should also notice that the green light on top of the Alpha will change to a brighter green when all the hardware components pass self check.

6. If the Alpha check box shows "**EXPIRED**", a PQ test will have to be performed before it is possible to analyze samples with the Spectro Oil Analysis macro. Click the "**EXPIRED**" box and the PQ test screen will appear, Figure 3.2-3. Press the "**Run Tests"** button to begin the tests. A message stating that the test is in process will appear, Figure 3.2-4.

NOTE: Make sure that the source has warmed up and has a check mark before running a PQ test.

7. After the tests are complete, an OVP results

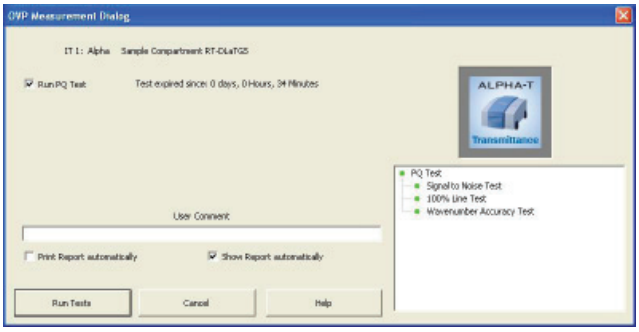


Figure 3.2-3, PQ Test Screen

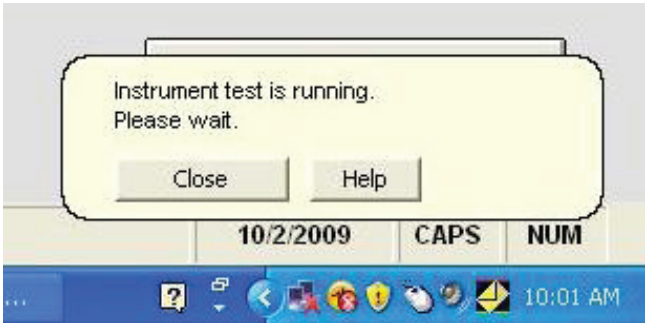


Figure 3.2-4, Test in Process

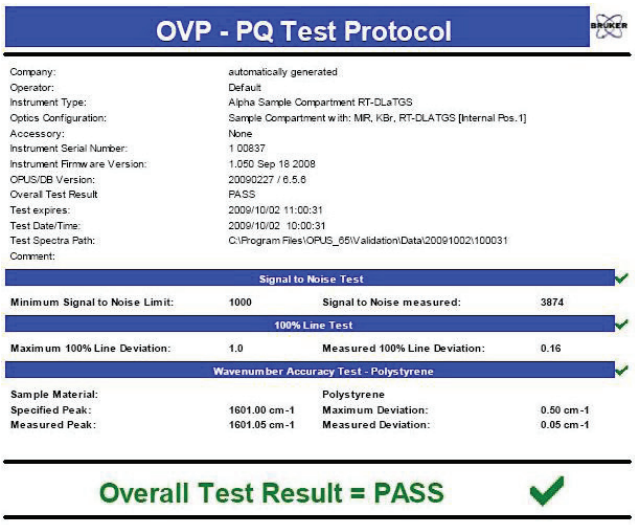


Figure 3.2-5, PQ Test Protocol

report is displayed and logged, Figure 3.2-5.

8. If the PQ test was successful, the diagnostic screen shown in Figure 3.2-6 will appear the following diagnostic screen should appear.

NOTE: You can also obtain this diagnostic screen at any time by pressing the circular button in the bottom

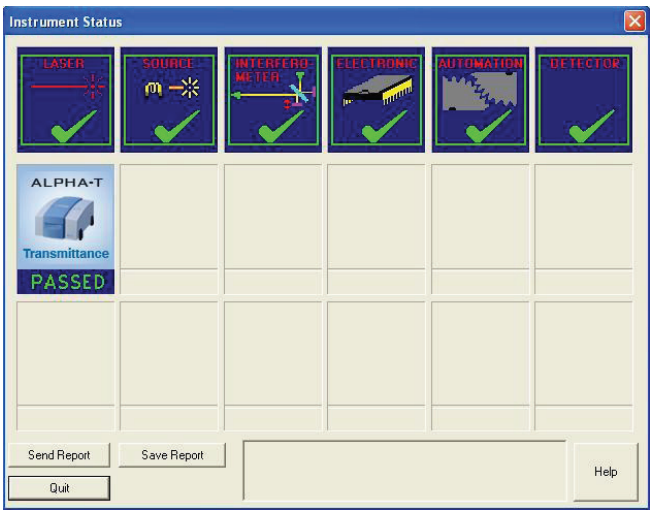


Figure 3.2.6, All Tests Successful

of the opus software – it could be yellow or red if there is a warning or error somewhere in the system, Figure 3.2-7. If it is green, no diagnostic tests are necessary.

The Spectro Oil Analysis Software can now be used to analyze samples. The software can be shut down and restarted while the Alpha is ON without repeating this routine.

If the Alpha is turned OFF and ON again, the source will need to warm up before the Spectro Oil Analysis Software can be used.



Figure 3.2-7, Diagnostic Test Status Indicator

3.3 LOADING THE FLIP-TOP CELL WITH A SAMPLE

The Spectro-FTIR Alpha uses a unique and patent-pending flip-top cell to analyze fluid samples. The cell's design makes it easy to load a sample and to clean the cell afterwards.

The procedure below describes how to load a sample into the flip-top cell.

1. To remove the cell and to load an oil sample into it, raise the sample compartment lid to gain access to the sample compartment.

2. Grasp the flip-top cell assembly and carefully slide it up and out of its holder, Figure 3.3-1.

3. Place the cell on a flat surface. Open cell by flipping the top half away from the bottom half, Figure 3.3-2.

4. Use one of the disposable, non-abrasive cleaning pads supplied with the Spectro-FTIR Alpha, a clean cloth or gauze pad to clean the cell, Figure 3.3-3. See also the side bar Note on Flip-Top Cell Cleaning Procedure.

5. With a pipette, place 1 to 2 drops of oil onto the window on the bottom half of the cell to just cover the window, Figure 3.3-4.

CAUTION: Do not place more than two drops of oil on the cell.

6. Close the cell by slowly lowering the top half until it rests on the shock absorber, Figure 3.3-5.

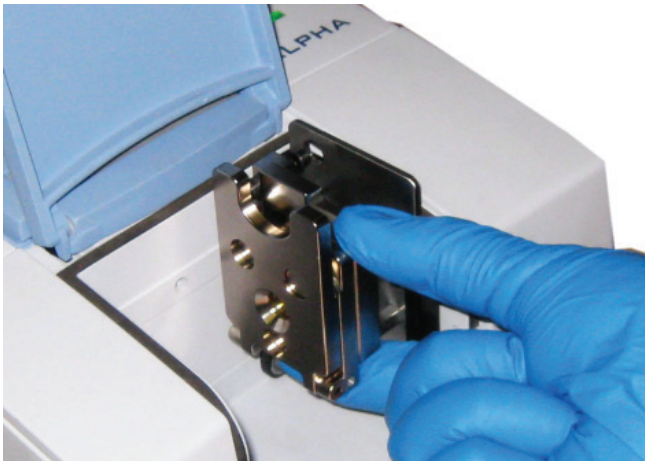


Figure 3.3-1, Remove Cell from Sampling Compartment

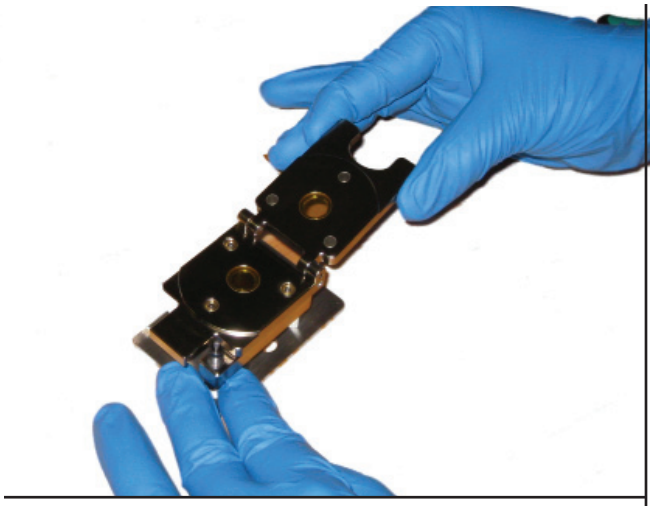


Figure 3.3-2, Open Flip-Top Cell

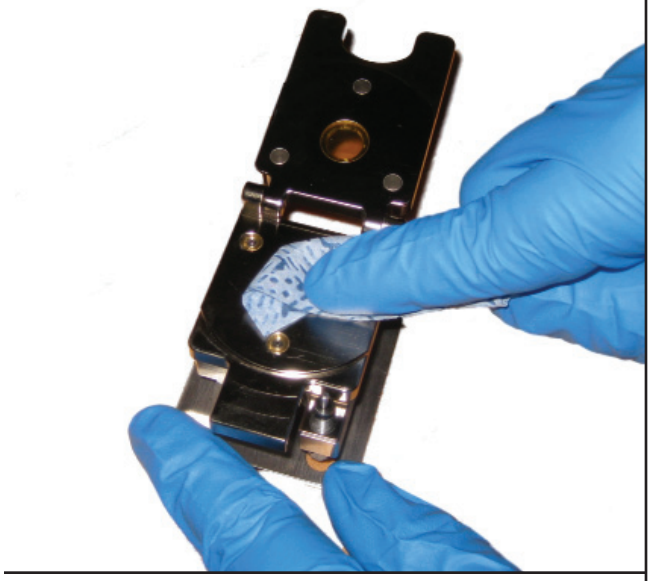


Figure 3.3-3, Clean Flip-Top Cell



Figure 3.3-4, Place Oil Sample on Cell Window

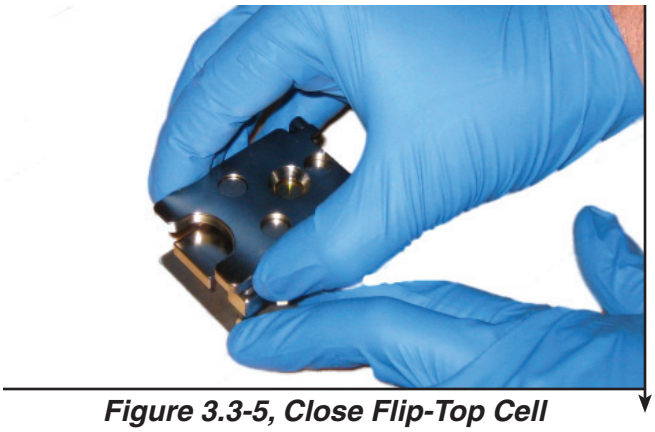


Figure 3.3-5, Close Flip-Top Cell

CAUTION: Do not force the halves together. The cell's shock absorber will slowly lower the top half of the cell onto the bottom. This takes only a few seconds but is extremely important because it eliminates air bubbles.

7. Grasp the closed cell and raise it straight up towards your eyes. While in the raised position, inspect the cell through the windows to confirm that there are no air bubbles present. If there are air bubbles, open the cell, wipe with a clean cloth or gauze pad and repeat step 5.

8. Replace the cell into the sampling compartment. Lower the cell straight down until it is seated in the "home" position of the holder, Figure 3.3-6. When installed, push again on the top of the cell to verify that it is seated all the way to the bottom of the holder.

9. Close the sample compartment lid by lowering it into the closed position.

10. The cell and the sample are now ready for analysis.

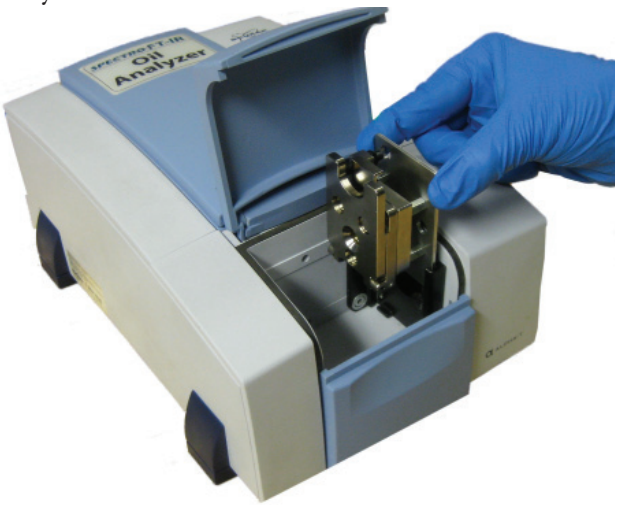


Figure 3.3-6, Replace Cell into Sampling Compartment

Note on Flip Top Cell Cleaning Procedure

The Flip top cell must be cleaned between samples and also before a background measurement is taken. The cell needs to pass the Spectro-FTIR Alpha factory cleanliness thresholds before a background is taken. To ensure the most accurate data the cell should be totally free of any residual oil films. Cleaning between samples does not need to be as thorough as the background measurement and a small residual film of oil should not affect the accuracy of the measurements. It is however recommended that the cleaning procedure outlined below remain the same for both backgrounds and for subsequent sample analysis between background measurements.

The cell can be cleaned with either a disposable non-abrasive cleaning pad supplied with the Spectro-FTIR Alpha or a clean cotton cloth – both provide suitable material which picks up the oil from the windows and also readily absorbs oil.

The cleaning method that has been proven to provide the easiest and quickest results involves removing the initial oil drop with a swipe of the cleaning material followed by successive swipes with clean areas of the material that do not contain oil. This process should be repeated until no visible residue is left on the window. You will find that more viscous oils like heavy gear oils require more swipes than a less viscous hydraulic oil. This cleaning process is used commonly to clean optical surface with alcohol to remove smudges and debris from lenses. Do not rub the cleaning material back and forth across the window to clean it, as this will leave a residue behind that may cause the cleanliness check to fail.

It is also recommended NOT to use volatile solvents routinely like IPA or Heptane to clean the window. The Flip Top cell is not sealed like a standard flow cell. The solvent vapors left behind will escape into the optical path and absorb IR light that will cause the cell to read dirty even though it maybe perfectly clean and free of oil and solvent.

In some rare cases it maybe necessary to use an oil solvent like Heptane to remove stubborn residue from the window if it cannot be removed using the conventional method. In this case we recommend leaving the Flip Top Cell open to dry for approximately half an hour after it has been cleaned with solvent

3.4 DETAILED STEPS TO RUN ANY METHOD

The Spectro-FTIR Alpha Oil Analysis Software is pre-loaded with standard analysis methods optimized for routine used oil analysis applications. Regardless of the method selected by the user, the analytical steps for an oil sample are identical. To process an oil sample, the software first checks cell cleanliness, performs a background measurement, checks cell cleanliness again and then process the sample for analysis.

1. Start the Spectro Oil Analysis Software by either double-clicking on the "**Spectro Oil Analysis"** icon on the PC desktop, or by selecting it from the "**Programs**" section of the "**START**" menu.

2. The Main Spectro FTIR Oil Analysis screen will open, Figure 3.4-1.

The figure shows the main operator screen. The left side of the screen contains a field that will display the result of each analysis to the operator. When the program is opened, the Analytical Results field will be empty. The results are concatenated (consecutively linked) unless the "**Clear Results List Before Each Measurement**" Option is selected in the Program Settings, Options 3 Tab, Section 3.5.4.

The right side of the screen contains all the operator controls. At the top of the screen are two text fields that must be completed to perform a sample measurement.

3. On the main analysis screen enter the operator's name or initials into the "**User's Name"** field. This will appear in all reports and databases.

4. Enter the sample or identification number for this sample into the "**Sample Number**" field. A new sample number is requested for each sample measured. The sample number can be numeric, alphabetical or a combination thereof.

5. Select one of the analysis methods in the list that corresponds to the type of oil being analyzed. The Spectro-FTIR Alpha software is delivered with the most common analysis methods required for in-service oil analysis including ASTM Standard Practice E 2412. If a Spectral Subtraction method has been selected, proceed with step 6, otherwise skip to step 9.

6. If the selected method requires a subtraction spectrum then the Subtraction Spectra section becomes active and will no longer be grayed out. Use the open folder button to the right of the field to locate and select the appropriate subtraction spectrum. This file must be measured and stored prior to the use of this analysis method. A sample file of Subtraction Spectra is shown in Figure 3.4-2.

7. Select the required Subtraction Spectra and click on "**Open**" to activate it. The selected spectra will now appear in the "Spectra for Subtraction" field, Figure 3.4-3.

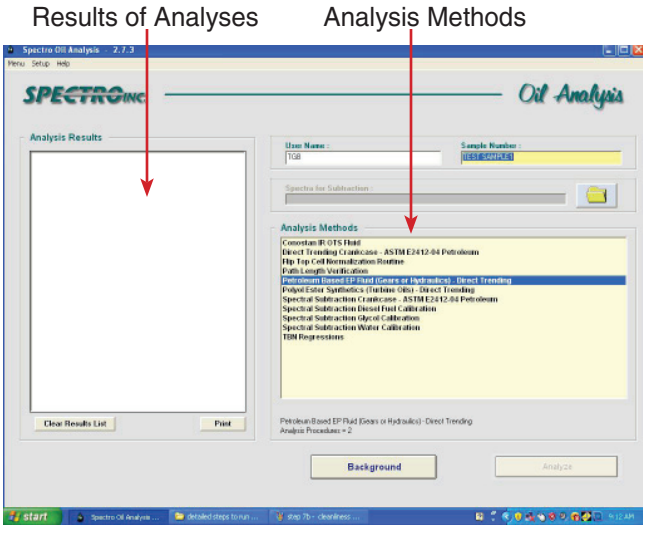


Figure 3.4-1, Main Analysis Screen

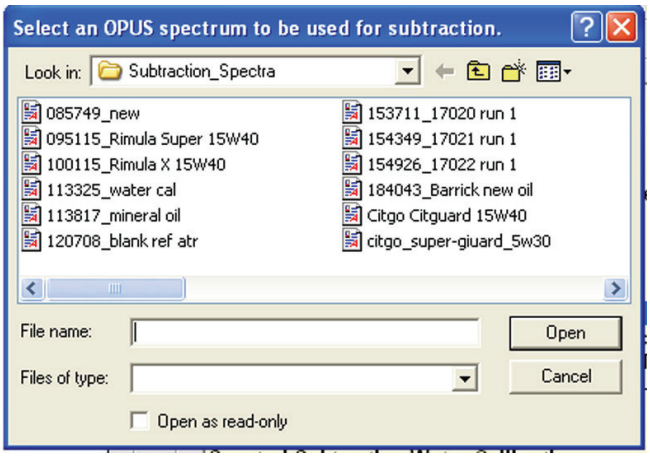


Figure 3.4-2, Subtraction Spectra Files

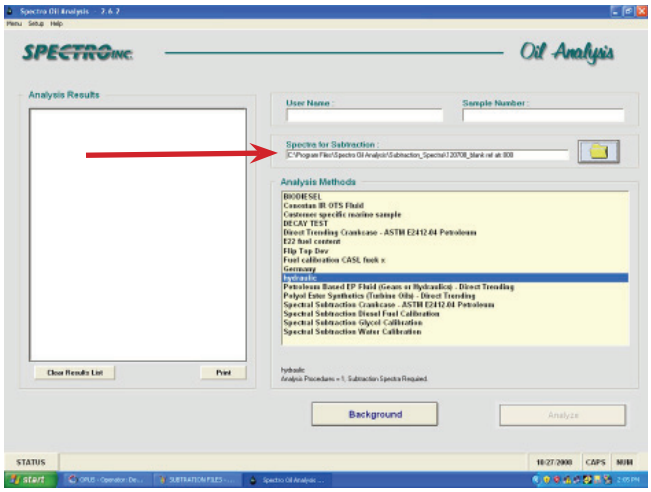


Figure 3.4-3, Subtraction File Selected

8. If a background measurement has been performed within the last hour, the "**Analyze**" button will be active and green. Proceed to step 15. If it not green, a background measurement must be performed, proceed with step 9.

9. Select the "**Background**" button by clicking on it to begin the sample background measurement. You will be warned if a required parameter is missing.

10. The measurement wizard will now ask you to clean the sample cell before proceeding, Figure 3.4-4. If the cell is dirty, remove it from the sample compartment, open it and clean it with a non abrasive cleaning pad. When the sample is clean or if it has been cleaned previously, select the "**Next**" button by clicking on it.

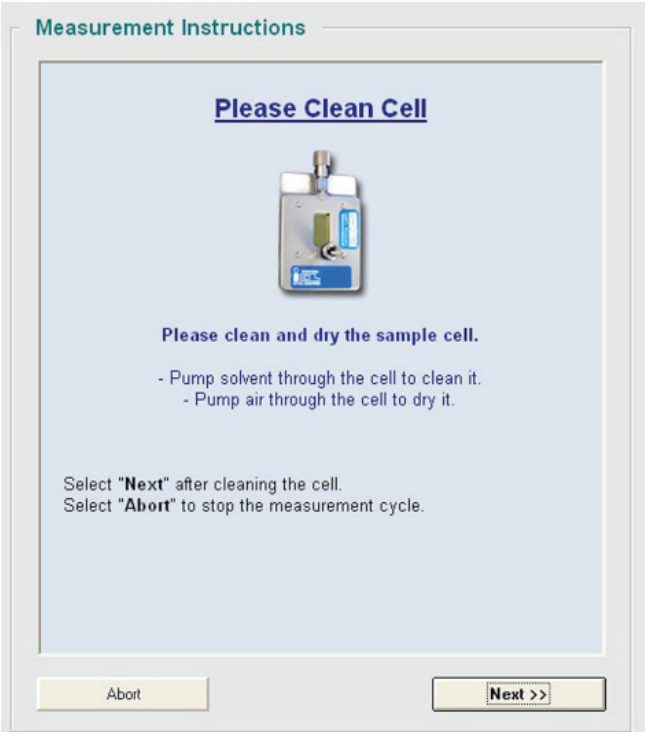


Figure 3.4-4, Please Clean Cell Screen

11. If the "**Cell Cleanliness Check**" option has been enabled in Program Options, Options 1 tab, Section 3.5.2., then the wizard will perform a cleanliness check of the cell, Figure 3.4-5. If the test fails you will be instructed to clean the cell again. The test must pass before a sample measurement can be performed.

11. When the cleanliness test passes, the screen in Figure 3.4-6 will notify you accordingly. Select the "**Next**" button to proceed.

12. The software now performs a background measurement, Figure 3.4-7.

13. When the background measurement is complete, the wizard screen will be blank and the "**Analyze**"button on the Main Analysis screen will be active, Figure 3.4-8.

14. Select the "**Analyze**" button and the software will perform another quick cleanliness test. When the test passes, the wizard screen will

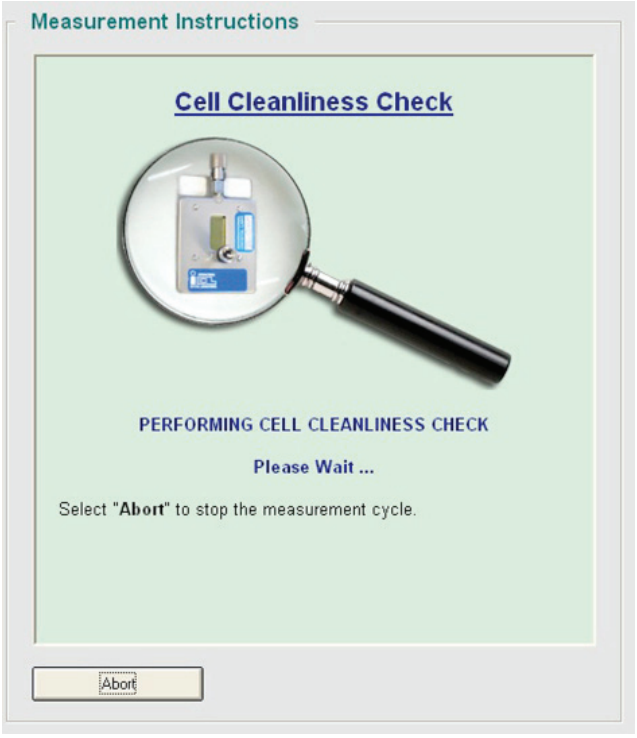


Figure 3.4-5, Performing Cell Cleanliness Check

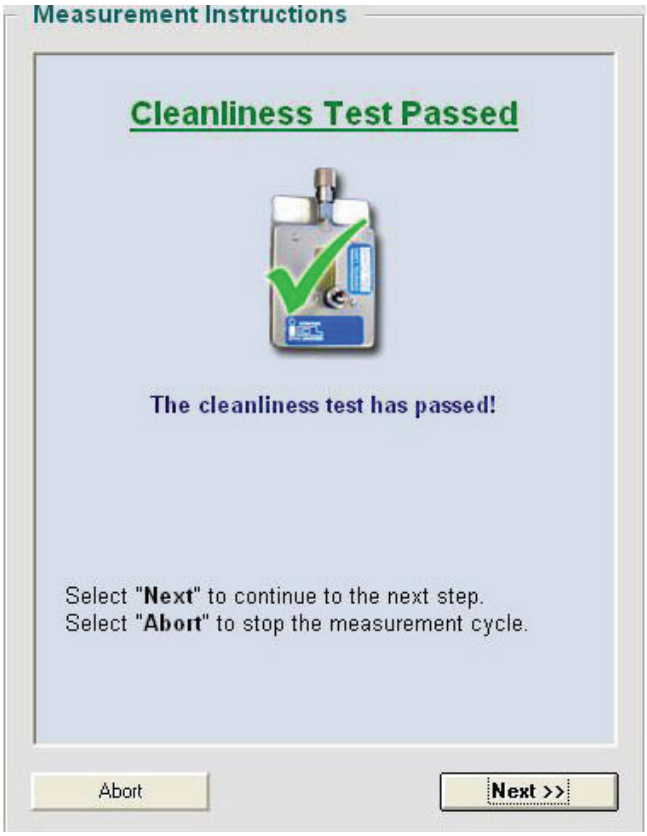


Figure 3.4-6, Cell Cleanliness Test Passed

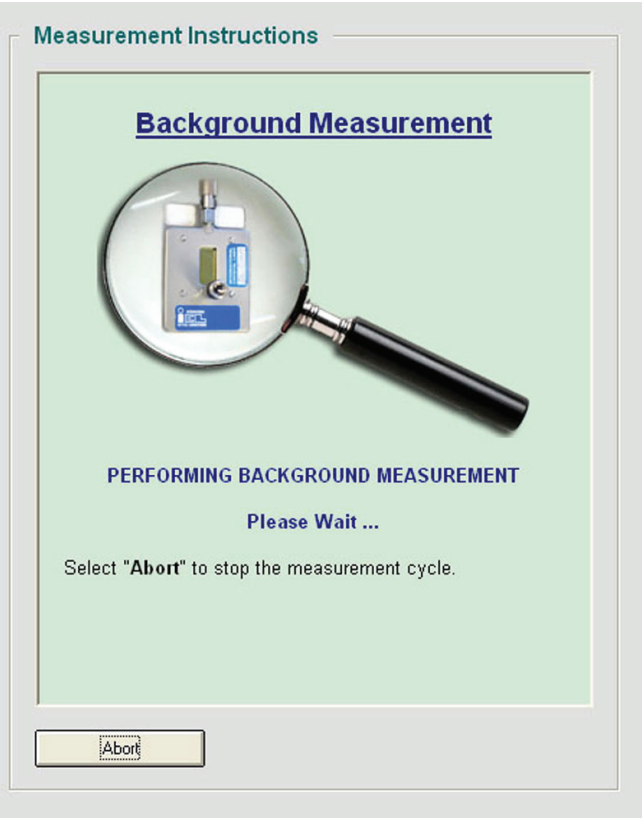


Figure 3.4-7, Background Measurement n Process

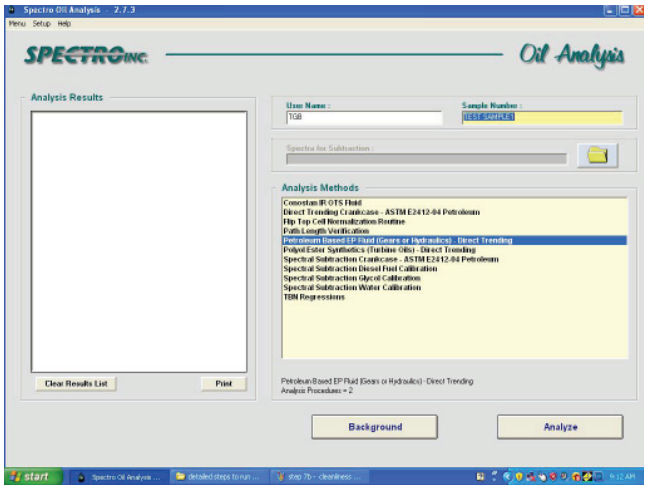


Figure 3.4-8, Background Measurement Complete

switch to the "Prepare to Analyze" screen, Figure 3.4-9.

15. Load a sample into the flip-top cell as described in Section 3.3. Replace the cell in the sample compartment, close it and select the "**Next**" button by clicking on it.

16. The wizard now informs you that the sample measurement process is taking place, Figure 3.4-10.

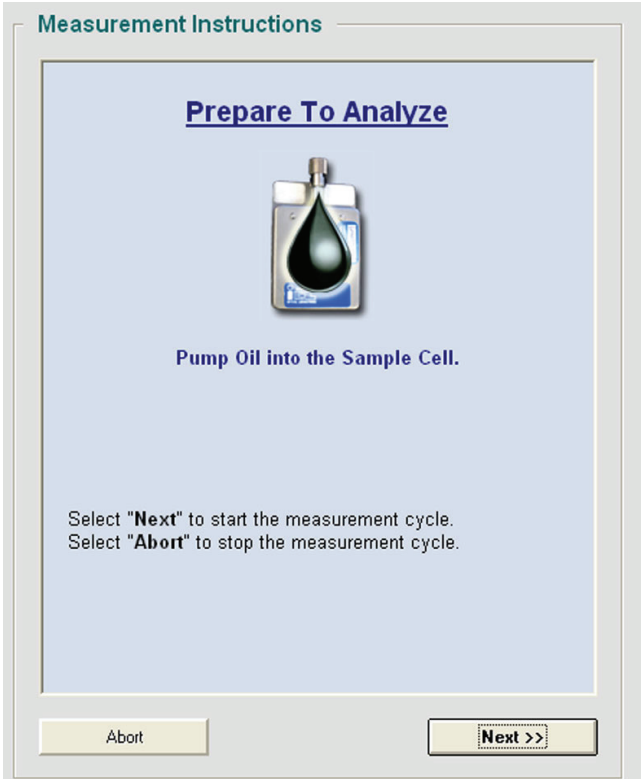


Figure 3.4-9, Alpha Ready to Analyze an Oil Sample

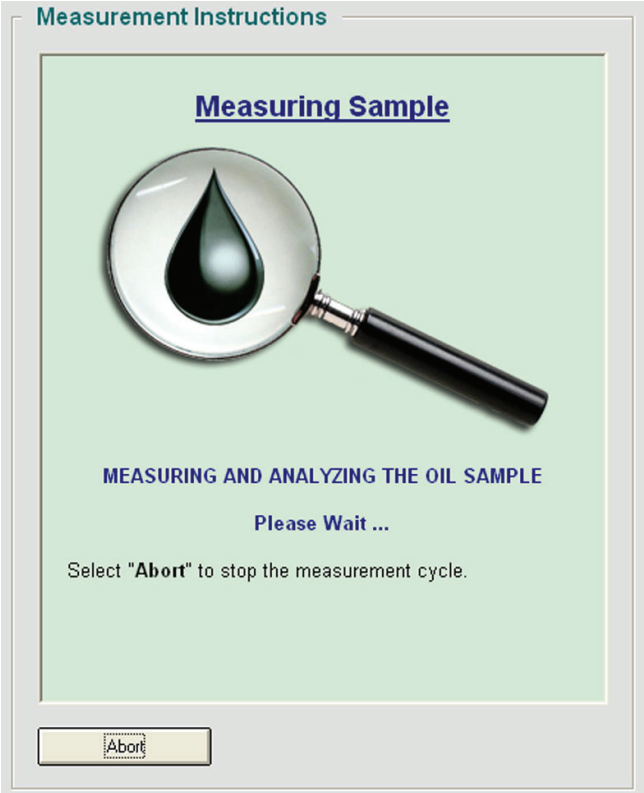


Figure 3.4-10, Analysis in Process

CAUTION: Do not touch the instrument during the measurement or subject it to harsh vibrations

17. When the measurement and analysis are complete the results will be displayed in the Analysis Results screen. A sample screen with a typical analytical result is shown in Figure 3.4-11.

If another analysis is performed at this time, the results are concatenated (consecutively linked) unless the "**Clear Results List Before Each Measurement**" Option is selected in the Program Settings, Option 3 Tab, Section 3.7.

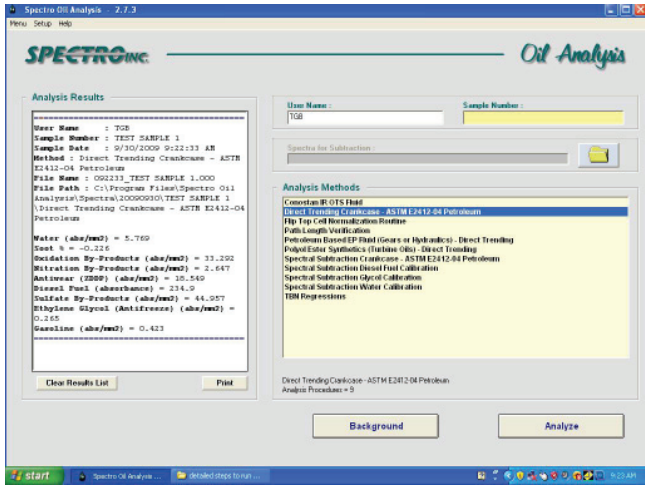


Figure 3.4-11, Analytical Results in Main Screen

18. Select the "**Clear Results List**" button to manually clear the analytical results at any time. Select the "**Print**" button to send the current text to a configured printer.

IMPORTANT NOTE: If you are not going to perform any additional sample measurements it is good practice to remove the flip-top cell, clean it and reinstall it in the sample compartment.

3.5 PROGRAM OPTIONS

The Program Options feature provides the user with alternative ways to configure and setup the Spectro-FTIR Alpha for the analysis of in-service oil samples. There are four option tabs; each contains program options and parameters that can be configured according to the analytical needs of the operator. The four available tabs and their options are described in this section.

To view the tabs, select "**Program Options**" from the "**Setup**" menu, Figure 3.5-1.

3.5.1 Options Tab 1

The Program Options, Option 1 tab is shown in Figure 3.5-2. The available settings and corresponding fields are explained in this section.

A. Last Diagnostic Message

The last error message received will be displayed in this field if hardware diagnostics are enabled, and a diagnostics error was reported

B. Cell Cleanliness Test

This option performs a cell cleanliness test on the sample cell prior to any background or sample measurement. A sample spectrum is recorded and integration is performed to determine the level of the CH band in the absorbance spectrum.

By default the cell cleanliness test is enabled. Click on the box to un-check this option if you do not want to perform a cell cleanliness test prior to each measurement.

Warning: A dirty sample cell could contaminate your oil sample and result in erroneous results.

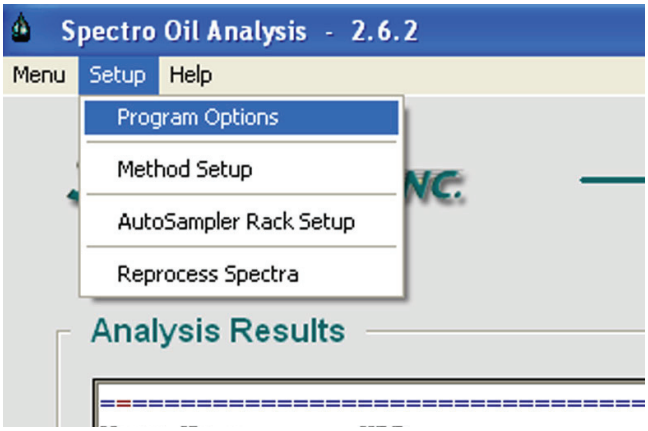


Figure 3.5-1, Setup Drop-down Menu

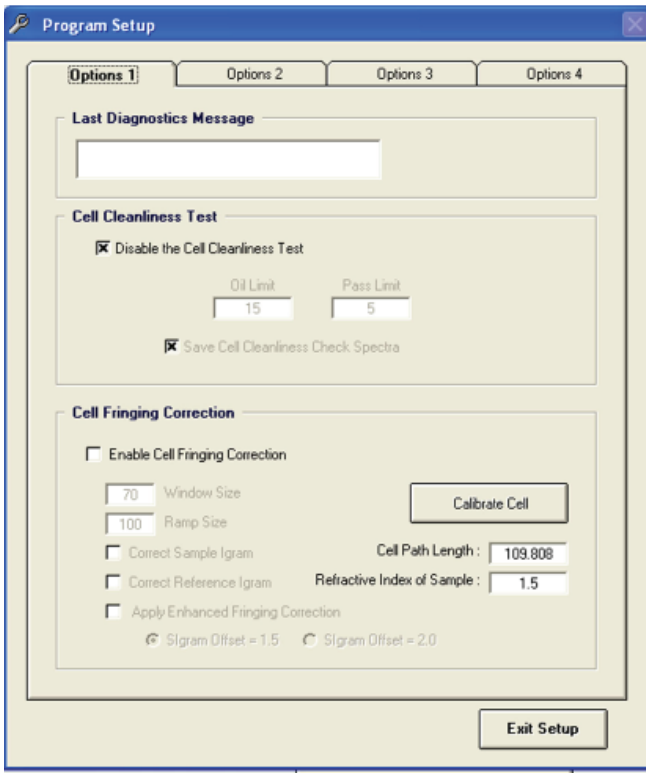


Figure 3.5-2, Options Tab 1

The next two fields are used to set values that determine cell cleanliness. The **Oil Limit** value is used during automatic sampling to determine if a cell requires additional solvent or air pumped through it to properly clean it. The **Oil Limit** is the prediction value above which oil is reported in the cell. The **Pass Limit** is the prediction value below which the cell is considered clean. Values between these two levels are thus considered residue from the solvent.

The spectra generated during the cell cleanliness test can be saved and archived. However, the default setting is to discard them after the test. In order to save the spectra, click on the **Save Cell Cleanliness Spectra** box to enable this feature.

C. Cell Fringe Correction

Fringe correction is not required for the flip-top or wedge cells, only for a standard floe-through cell. Standard sample cells, exhibit fringing characteristics in the sample spectrum due to multiple reflections within the sample cell. This option eliminates most of the effect of fringing from the cell.

By default, this option is disabled. To enable it you must first calibrate the cell to determine the cell path length. The procedure to calibrate the cell is detailed in Section 3.1.2.

Upon completion of the cell calibration procedure, the program computes the **Cell Path Length**, and the option to enable the **Cell Fringing Correction** becomes available.

The **Refractive Index of Sample** value is used to compute the fringing correction. This is the refractive index of the material used to create the sample cell. The default value corresponds to the sample cells currently used in the Spectro-FTIR.

The **Window Size and Ramp Size** options are used to determine how the correction algorithm is applied to the interferogram. The default values of 70 and 100 are shown in the figure. An increase in these values will cause a loss of information in the spectrum, or if they are set too low, the fringing will become more evident.

The **Correct Sample Igram** and **Correct Reference Igram** options determine if the fringe correction will be performed on the sample and/or reference (background) interferograms. Generally both should be selected, however on some sample cells the fringing is not noticeable on the reference (background) interferogram. In that situation the **Correct Reference Igram** option can be deselected.

The **Apply Enhanced Fringe Correction** optionis used to cancell out second order harmonics and only applies when samples that are extremely clear and clean are processed. If the instrument is giving poor repeatability on clean samples, select this option along with the 2. Sigram Offset.

3.5.2 Options Tab 2

The Program Options, Option 2 tab is shown in Figure 3.5-3. The available settings and corresponding fields are explained in this section.

A. Program Files

This section of the Options 2 tab defines the files and folders used by the Spectro Oil Analysis Software. Default values are included.

Analysis Methods Database File:

This is the file containing the definitions for the different oil analysis methods. If you move the file to a different location you should select it using the open folder button to the right of the field.

Experiment Method File:

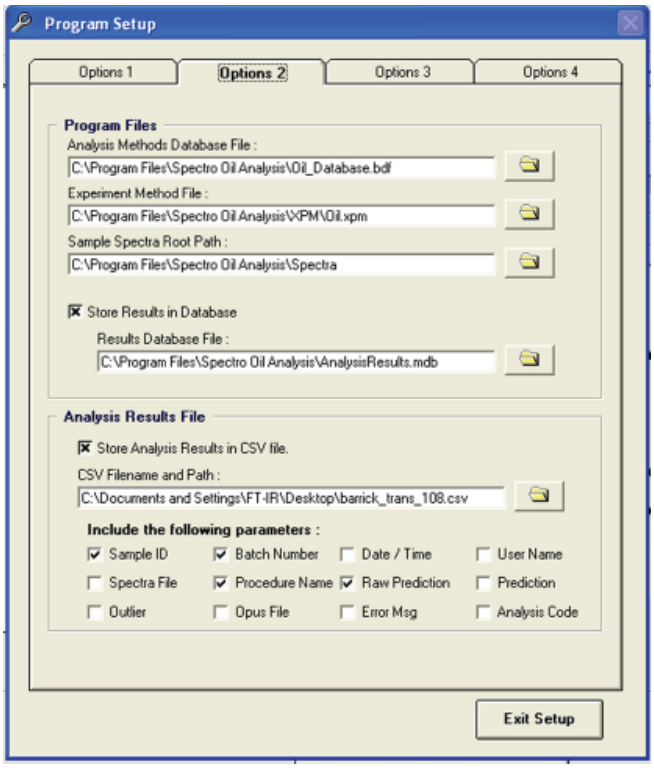


Figure 3.5-3, Options Tab 2

This is the parameter file used by the OPUS program to perform the sample and background measurements. Any experiment method file (xpm) can be used as long as it is compatible with the analysis method(s) being used. One file will be used for all measurements.

Sample Spectra Root Path:

This is the root folder where all spectra measured by the program will be stored.

The **Store Results in Database** is disabled by default, however, it is good practice to activate it to archive analytical results for future reference. It is also not possible to review or print reports unless the option is enabled. When enabled, all results from analyses are stored in a Microsoft Access database. The filename and path can be specified in the field below the option.

B. Analysis Results File

When selected, the **Store Analysis Results in CSV** file option stores the results of each measurement in a comma-delimited text file. The results can then be imported into a spreadsheet or other program such as the LabTrak Oil Analysis Information Management System.

The field below the option checkbox specifies the

filename and path of the file.

The remaining checkboxes are used to specify what information is stored in the file. These are in the order (left to right, top to bottom) that they will appear in the file. Typical selections are shown in the figure.

3.5.3 Options Tab 3

The Program Options, Option 3 tab is shown in Figure 3.5-4. The available settings and corresponding fields are explained in this section.

A. Setup Password

Select this button to create/edit/delete a password to protect the Setup menu options. When a password has been set, the user must enter the correct password before access is granted to any of the options on the **Setup** menu.

Click on "**Set Password**" and a dialog window appears that allows you to edit or delete the password. Press the "**Enter**" key when changes have been made.

B. Options

This section contains general program options that did not fit into a particular category.

By default the program is in manual operation mode and fuel pumping and cleaning must be performed manually. Select the Automatic Measurement Mode option to enable the use of the AutoSampler and pump under computer control to measure a rack of samples automatically. Refer to Automatic Operation, Section 3.4, for more information.

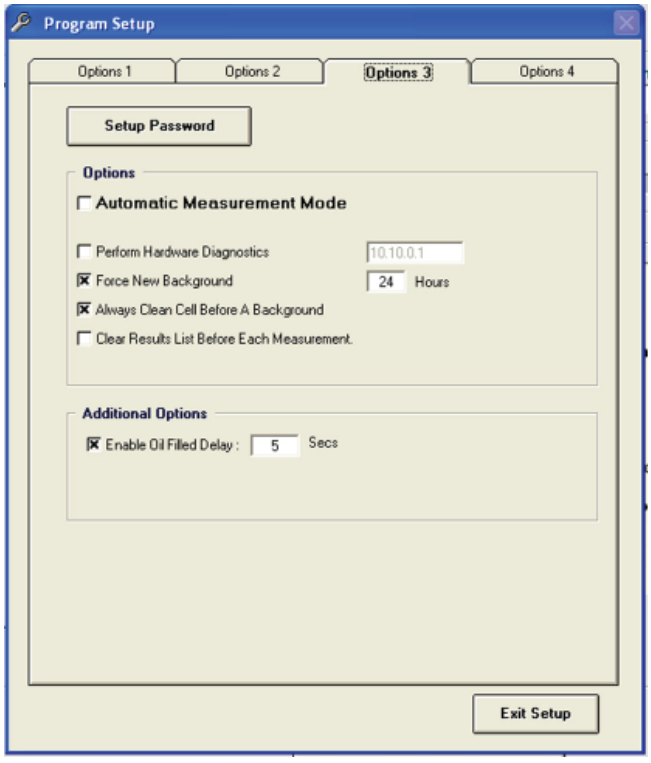


Figure 3.5-4, Options Tab 3

Enable **Perform Hardware Diagnostics** option to perform hardware diagnostics on the spectrometer prior to each measurement cycle. The field to the right of the checkbox contains the URL for the spectrometer. The default URL is entered, however if you have changed your spectrometer settings you need to update this field.

A new background measurement is required each time the program is started. When selected, the **Force New Background** option makes it mandatory to perform a new background measurement after a specified period of program operation. This is useful if the program is never shutdown during day-to-day usage. The field to the right of the checkbox specifies the time period between background measurements in hours. A minimum setting of 24 hours is recommended, however, more frequent measurements may be required if the laboratory experiences repeated environmental changes.

The **Always Clean Cell Before a Background** option forces the program to clean the sample cell prior to a background measurement in automatic measurement mode.

The **Clear Results List Before Each Measurement** option clears the main screen list of analysis results between each measurement. When disabled the results are appended until the user manually clears the list.

3.5.4 Options Tab 4

The Program Options, Option 4 tab is not applicable to the Spectro-FTIR Alpha. It applies only to the standard Spectro-FTIR with autosampler.

3.6 FLIP-TOP CELL MAINTENANCE ROUTINES

This section describes routines to verify the cell path length to confirm that it has not changed beyond acceptable limits and if so, a routine to normalize the cell path length to bring it back into allowable performance specifications.

3.6.1 Verify Cell Path Length

In use, the windows of the cell can wear and thereby change the path length in the window where the sample is viewed and analyzed. An indication of this may be a drift, over time, in analytical results.

This test will determine if the path length has deviated more than 2%. It performs a simple algorithm whereby 100% is perfect and anything below 98% or above 102% is unacceptable and reported with a warning message.

NOTE: Do not confuse the cell path length verification numbers with cell distance in micrometers. The verification method produces a number based on a percentage where 100% is perfect. It is an algorithm that determines change, and is not a measurement.

The cell Path Length Verification test is a standard analysis method and performed the same way as a routine oil sample. The only difference is that the IR Check Fluid, part number FL310, that is supplied with the Spectro-FTIR Alpha is used for the test.

To perform the Path Length Verification test:

1. Start the Spectro Oil Analysis Software by either double-clicking on the "**Spectro Oil Analysis**" icon on the PC desktop, or by selecting it from the "**Programs**" section of the "**START**" menu.

2. The Main Spectro FTIR Oil Analysis screen will appear. Select "**Path Length Verification**" from the Analysis Methods, Figure 3.6-1.

3. Perform a normal analysis as described in Section 3.4, consisting of a cleanliness test, and if expired, a background measurement.

4. When the wizard measurement instructions state **"Prepare to Analyze"**, load the flip-top cell with the IR Check Fluid, part number FL310.

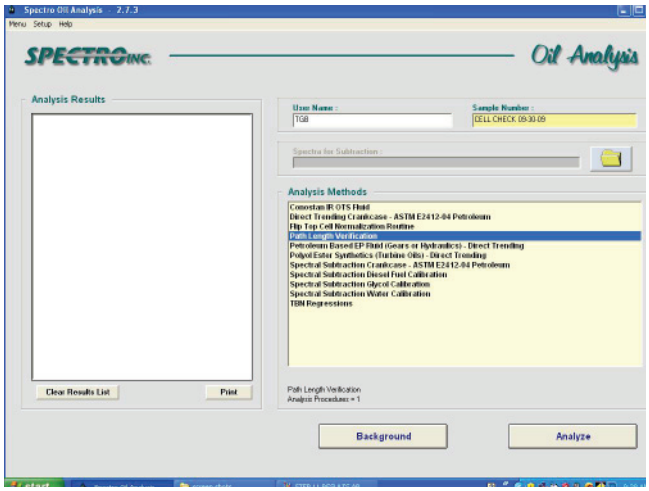


Figure 3.6-1, Select Path Length Verification

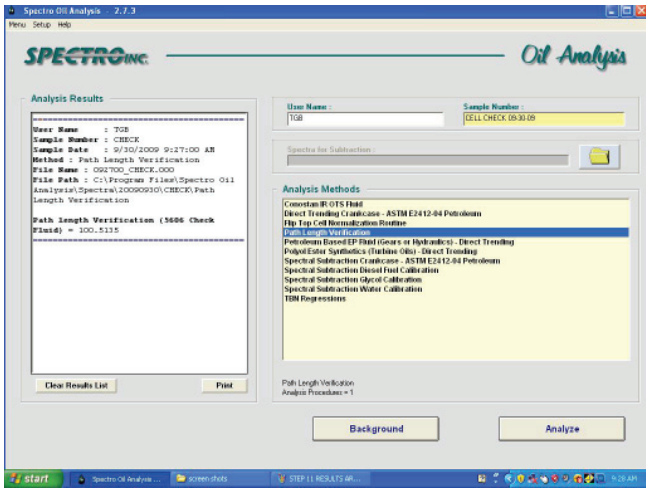


Figure 3.6-2, Path Length Verification Results Screen

5. When the analysis is complete, the verification data will be listed in the Analysis Results section of the main analysis screen, Figure 3.6-2.

6. A path length verification between 98% and 102% is acceptable and the test is complete. If not, there will be an error message. Repeat the procedure a second time to verify the failure. If it fails a second time the Flip Top Cell Normalization Routine in Section 3.6.2 must be performed.

3.6.2 Flip-Top Cell Normalization Routine (Re-calibration)

This routine provides a means to normalize (re-calibrate) the path length of the cell if it failed the Cell Path Length Verification. This ia also a standard analysis method but is performed with the IR Check Fluid.

To perform a Flip-Top Cell Normalization routine:

1. Start the Spectro Oil Analysis Software by either double-clicking on the "**Spectro Oil Analysis**" icon on the PC desktop, or by selecting it from the "**Programs**" section of the "**START**" menu.

3. The Main Spectro FTIR Oil Analysis screen will appear. Select "**Setup**" and from its drop-down menu, select "**Program Options**", Figure 3.6-3.

4. The Program Setup screen, Figure 3.6-4 appears. The tab for "**Options 1**" should be the default tab, if not select it by clicking on its tab.

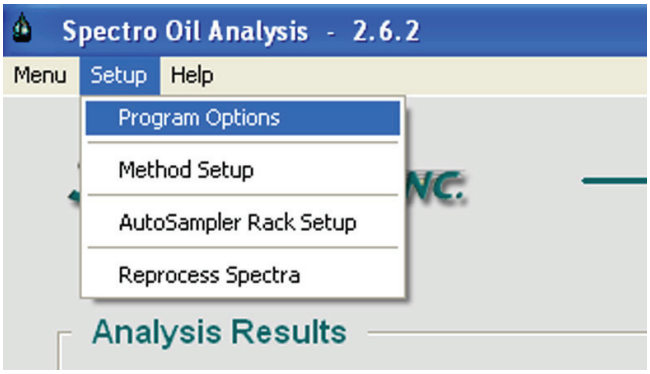


Figure 3.6-3, Setup Drop-down Menu

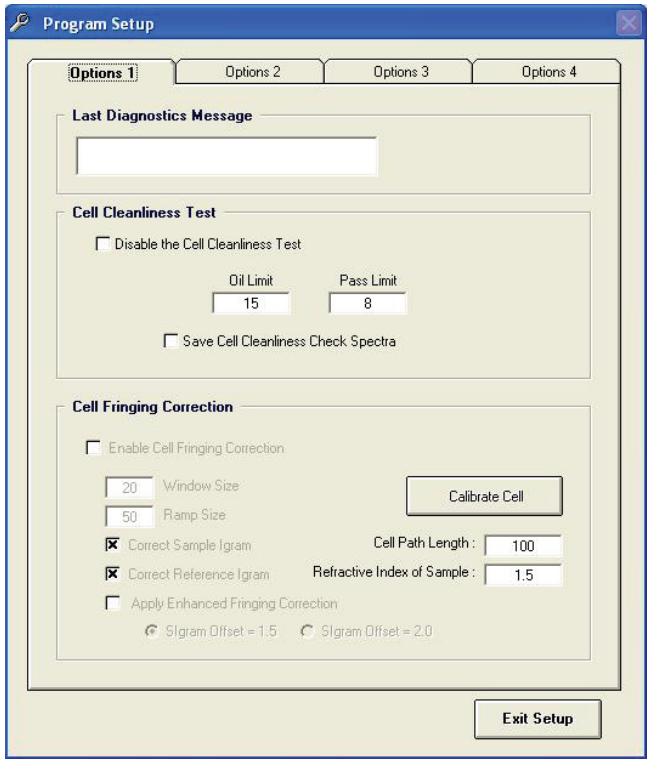


Figure 3.6-4, Enter "100" Into Cell Path Length Field

5. The cell path length is entered into the Cell Path Length field in the lower right hand corner of the tab. Enter "**100**" into the field regardless of the results obtained in Cell path length Verification procedure. (The value of 100 is used to "normalize" the actual cell to bring it back to acceptable performance limits.

6. Click on "**Exit Setup**" to complete the entry.

7. The Main Spectro FTIR Oil Analysis screen will re-appear. Select "**Flip-Top Cell Normalization Routine**" from the Analysis Methods, Figure 3.6-5.

8. Perform a normal analysis as described in Section 3.4, consisting of a cleanliness test, and ensure that a new background is recorded each time.

9. When the wizard measurement instructions state "**Prepare to Analyze**", load the flip-top cell with the IR Check Fluid, part number FL310.

10. When the analysis is complete, the normalized path length will appear in the Analysis Results section of the Main Analysis screen.

11. Repeat 8 through 10 three times and take an average of the three cell path lengths.

12. From the Main Spectro FTIR Oil Analysis screen, select "**Setup**" and from its drop-down menu, select "**Program Options**" again.

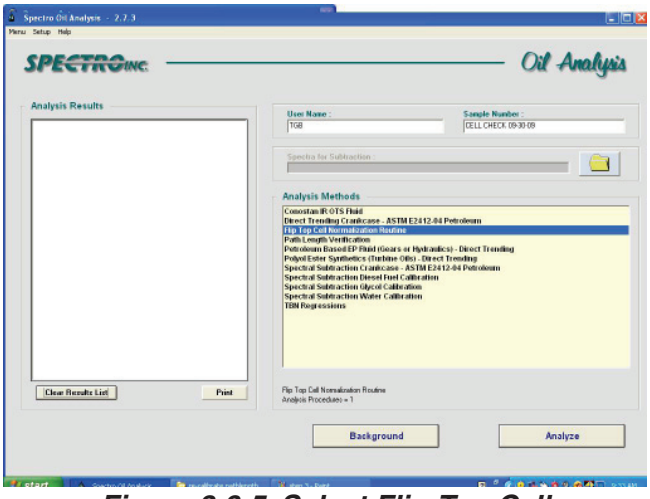


Figure 3.6-5, Select Flip-Top Cell Normalization Routine

13. The Program Setup screen, Figure 3.6-4 re-appears. The tab for "**Options 1**" should be the default tab, if not select it by clicking on its tab.

14. The cell path length is entered into the Cell Path Length field in the lower right hand corner of the tab. Enter the average value of the three normalization routines obtained in step 11. This will be used as the new, re-calibrated cell path length.

15. Click on "**Exit Setup**" to complete the entry.

Chapter 4

Maintenance, Repair & Troubleshooting

4.0 MAINTENANCE , REPAIR & TROUBLESHOOTING

The Spectro-FTIR Alpha is a low-maintenance instrument. In routine use, the operator can replace components that have limited service life. The following maintenance procedures are described in this chapter:

- Replacing IR source
- Replacing desiccant
- Replacing windows
- Cleaning windows
- Cleaning spectrometer housing

CAUTION: Perform only the maintenance procedures described in this manual. Strictly observe the relevant safety precautions. Any failure to do so may cause property damage or personal injury. In this particular case Spectro does not assume any liability. Maintenance or repair procedures not described in this manual should only be performed by a Spectro service engineer.

4.1 REPLACING THE IR SOURCE

ALPHA uses a highly-efficient, low power, air-cooled infrared source with an average specified lifetime of about 44,000 operating hours. The OPUS software will provide a notification prior to reaching the end of the source's lifetime. The following message will pop-up:

"End of average lifetime is nearly reached, spare part will be required."

When this occurs, the OPUS status light gives ample warning by turning yellow. This will provide time to order a replacement source, part number 1005855.

If the source is defective, the OPUS status light turns red. The following message pops up in OPUS:

"Source is broken".

When this happens, it is not possible to operate the instrument and the source must be replaced.

4.1.1 Source Replacement Procedure

To replace the IR source:

1. The source is accessible from the rear of the spectrometer, Figure 4.1-1.

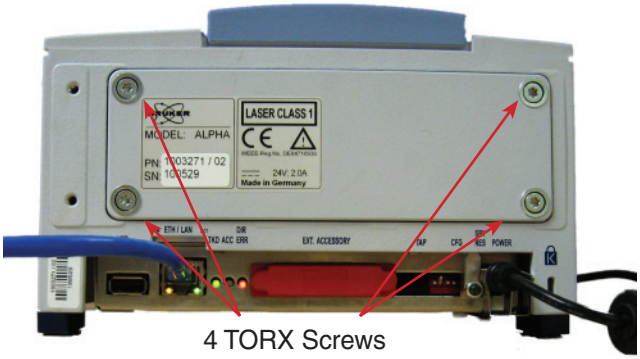


Figure 4.1-1, Rear View of Cover Plate

2. Turn OFF power the Spectro-FTIR Alpha by unplugging the connector from the Power Port.

3. The rear cover plate is secured with four TORX screws. Use the TORX TX20 screw driver supplied with the Spectro-FTIR Alpha to remove the four screws.

4. Remove the cover plate and set it aside.

***CAUTION**: The light source becomes very hot during operation and if touched, it could burn your skin. Wait until the source has cooled down sufficiently before you start to replace it.*

5. The source is held in place by two TORX screws, Figure 4.1-2. Use the supplied TORX T20 screw driver to loosen and remove the screws.

6. Remove the green source plug by pulling it straight towards you. The will be a "beep" when it is removed.

7. Pull the source out from the spectrometer.

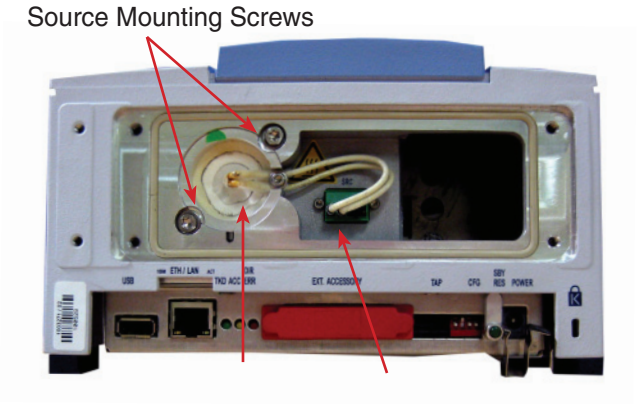


Figure 4.1-2, Rear View with Cover Removed

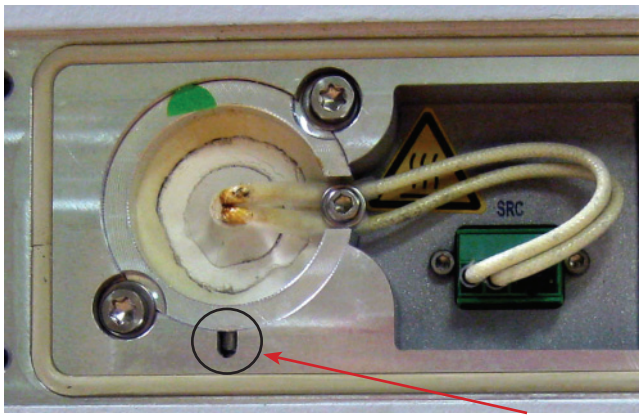


Figure 4.1-3, Location of Source Alignment Pin

Note the alignment pin on the source and how it fits into the alignment groove.

8. Insert the new replacement source into the spectrometer. Make sure that the alignment pin on the source fits correctly into the alignment groove.

9. Replace the two TORX screws that hold the source and tighten with the screw driver.

10. Connect the green source plug into its connector. There will be a "beep" when it is connected.

11. Replace the rear cover and the four TORX screws that hold it in place. Tighten the TORX screws with the screw driver.

12. This completes the source replacement procedure. Continue with the instrument test as described in the next section.

4.1.2 Performing and Instrument Test

The Instrument Test must be performed to qualify and confirm that the Spectro-FTIR Alpha is ready to resume the analysis of in-service oils.

1. The OPUS Wizard Bar is used to initiate the instrument test. If it is not already part of your tool bars, from the **View** menu, select **Wizard Bar**, Figure 4.1-4 to activate it.

2. Click on the Instrument Test Button on the OPUS wizard, Figure 4-1-5. The test will take approximately 5 minutes.

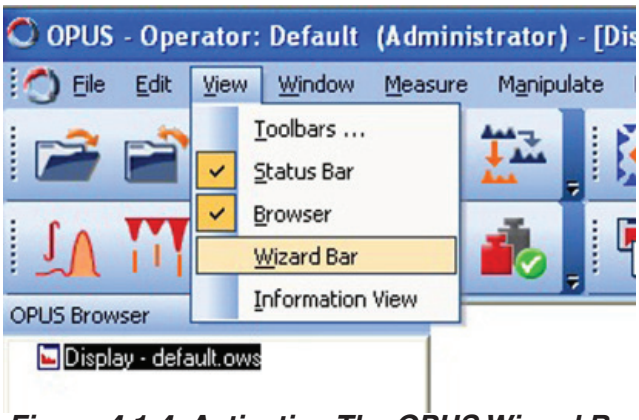


Figure 4.1-4, Activating The OPUS Wizard Bar

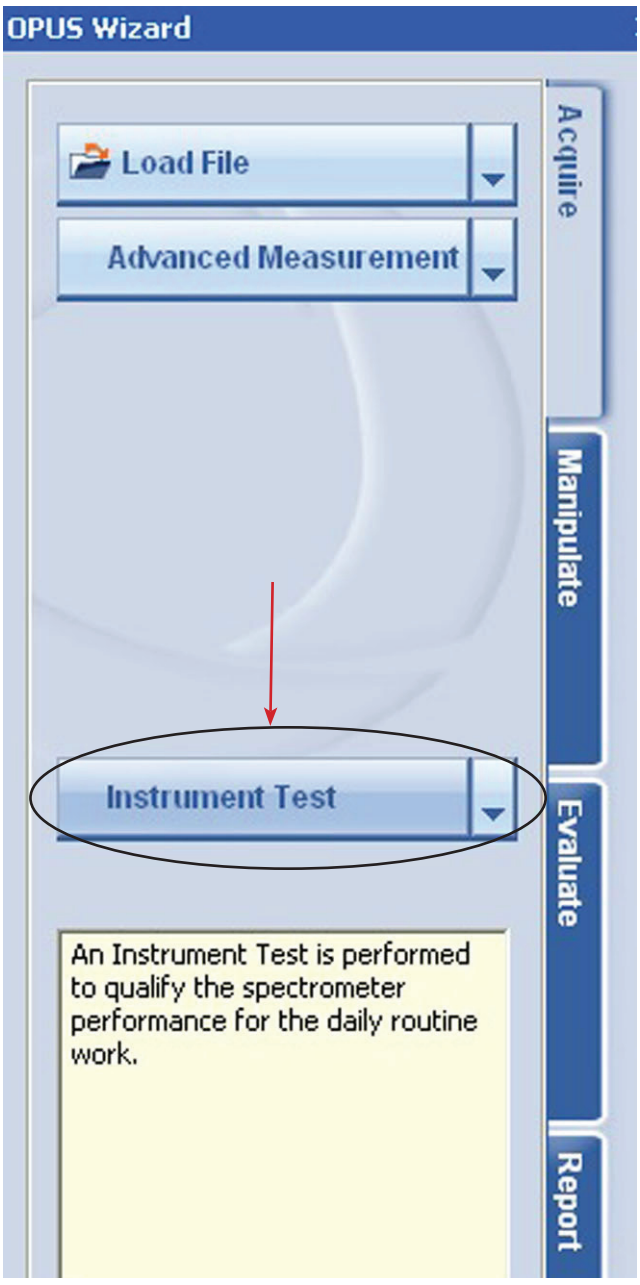


Figure 4.1-5, Instrument Test Button

3. If the test passed, the OPUS status light will turn green and the test is complete.

If it failed, the status light turns red signifying that either the replaced source, or another component is defective. The instrument status dialog will open to provide more information. Contact Spectro Inc. Service Support if the laser, interferometer, or electronics are defective.

4.1.3 Resetting the Source Operating Hours

The source hours should be reset to zero whenever the source has been replaced.

1. Click on the green OPUS status light, Figure 4.1-6.

2. The Instrument Status dialog opens, Figure 4.1-7.

3. Click on the Source icon and another dialog will open.

4. Click on the Reset button in the opened dialog. If the Reset button is deactivated, click on the help button and repeat the procedure.

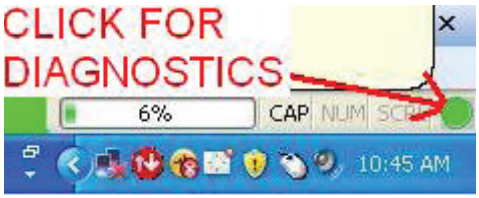


Figure 4.1-6, OPUS Status Light

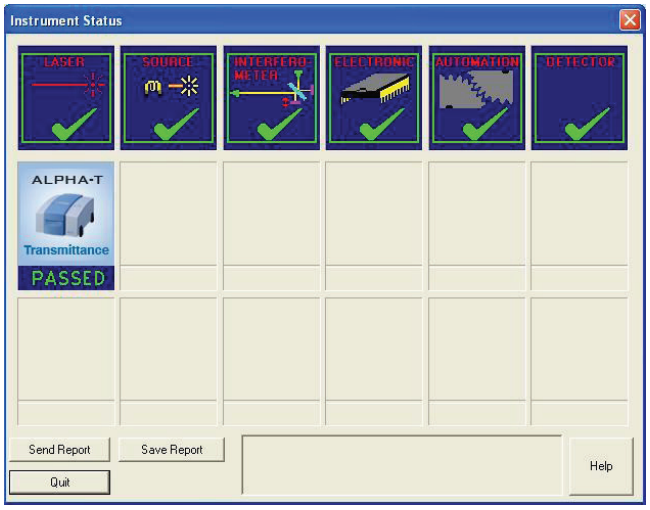


Figure 4.1-7, Instrument Status Dialog Screen

4.2 Replacing Desiccant Bags

Too high a humidity in the spectrometer can result in water bands appearing in the spectrum that interfere with performance. The air inside the spectrometer is kept dry with a desiccant which is enclosed in removable bags.

When the desiccant is saturated and needs to be replaced, a "**Humidity out of range"** error message is displayed and the OPUS status light turns yellow. It is still possible to operate the Spectro-FTIR Alpha with the yellow warning light, however, the desiccant should be replaced as soon as possible. Replacement desiccant bags can be ordered from Spectro Inc. , part number 1000917.

To replace the desiccant bags:

1. The desiccant bags are accessible from the rear of the spectrometer, Figure 4.2-1.

2. Turn OFF power the Spectro-FTIR Alpha by unplugging the connector from the Power Port.

3. The rear cover plate is secured with four TORX screws. Use the TORX TX20 screw driver supplied with the Spectro-FTIR Alpha to remove the four screws.

4. Remove the cover plate and set it aside.

5. Pullout the used desiccant bags. Needle nose pliers or tweezers may be helpful.

6. The replacement desiccant bags are stored in etra packaging. Open the packaging and remove the desiccant bags.

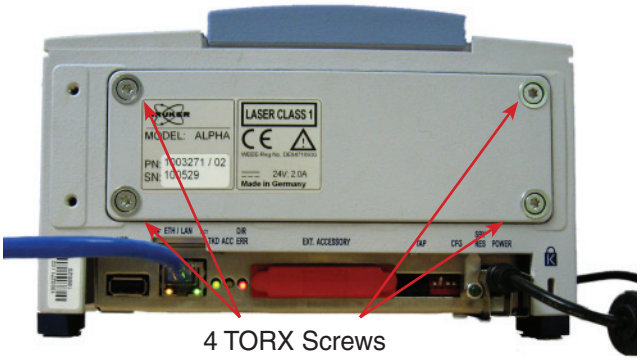


Figure 4.2-1, Rear View of Cover Plate

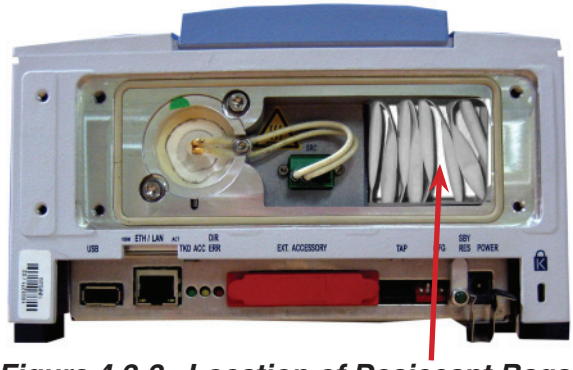


Figure 4.2-2 , Location of Desiccant Bags

CAUTION: Do not cut the packages into single pieces. Do not ingest the desiccant.

7. Insert the replacement deiccant bags into the spectrometer as shown in Figure 4.2-2.

8. Replace the rear cover and the four TORX screws that hold it in place. Tighten the TORX screws with the screw driver.

9. This completes the desiccant replacement procedure. Continue with the instrument test as described in the next section.

4.3 REPLACING WINDOWS

The windows in the Spectro-FTIR Alpha for the infrared (IR) beam are made of zinc selenide (ZnSe). Unlike potassium bromide (KBr) windows, the ZnSe versions do not become opaque with time. The windows in the Spectro-FTIR Alpha therefore only need to be replaced if they are broken.

The window replacement procedure is the same for both windows. To replace a window:

1. To remove the measuring module from the basic module, press down on the lock to release the two parts, Figure 4.3-1.

2. The Spectro-FTIR Alpha has two ports for the infrared (IR) beam, an output and an input port, Figure 4.3-2. A special assembly tool supplied with the instrument is used to remove a window.

3. Insert the two pins of the assembly tool into the corresponding holes on the window frame, Figure 4.3-3.



Figure 4.3-1, Push Lock Release to Separate Measurement Module from Basic Module

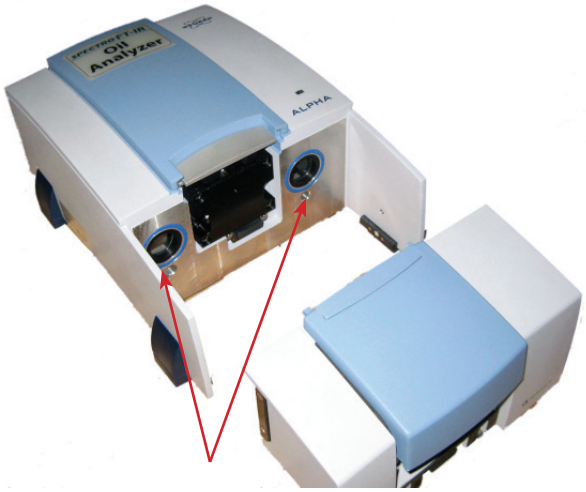


Figure 4.3-2, SnZe Windows for IR Ports

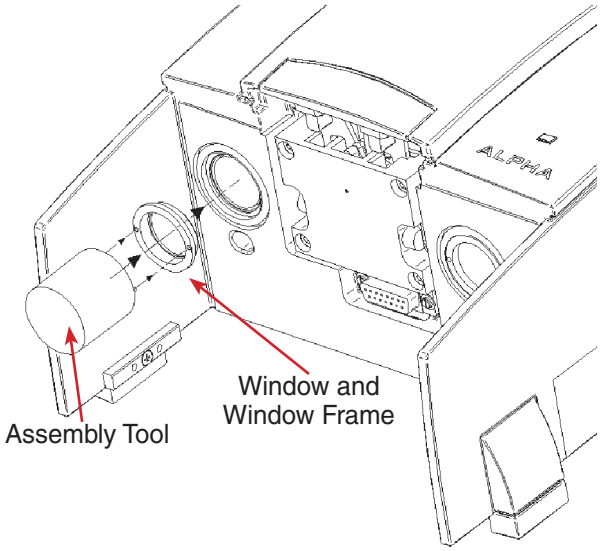


Figure 4.3-3, Assembly Tool for Windows

4. Rotate the tool counterclockwise several turns and remove the window and its frame.

5. To install a replacement window, insert the pins of the assembly tool into the corresponding holes of the window frame.

6. Place the window into its hole and rotate the assembly tool clockwise until it is snug. Remove the assembly tool.

7. Re-assemble the Spectro-FTIR Alpha by sliding the measurement module back against the basic module. Hold down the lock to reengage the two sections.

8. An instrument test must be performed to confirm the Spectro-FTIR Alpha is ready to resume analyses. See Section 4.1.2 and follow the procedure.

9. This completes the window replacement procedure.

4.4 CLEANING WINDOWS OR THE HOUSING

To clean windows, use only a dry, lint-free cloth. Do not use water or solvents.

The outer surfaces of the spectrometer can be cleaned using a dry or damp cloth. Do not use detergents, solvents or acids.

4.5 TROUBLESHOOTING

This section describe problems with the Spectro-FTIR Alpha that can be resolved by the user. In all other cases contact the Spectro Inc. Service Department.

4.5.1 General Information

A spectrometer problem can be indicated as follows:

- The status light at the spectrometer top side lights yellow or red or not at all.
- The OPUS status light is yellow or red or gray.
- The instrument test/performance test failed. (In this case, a test protocol is automatically displayed.)
- Error messages in OPUS
- Diagnostics LEDs at the spectrometer rear side

These diagnostic means allow to find out the cause of a spectrometer problem and to solve it by yourself, or at least to narrow down the cause of the problem. If the solutions listed below do not solve the problem, contact the Spectro Inc. Service department.

4.5.2 Spectrometer Status Indicator

The Spectro-FTIR Alpha status indicator is an LED on the top side of the basic unit, Figure 4.5-1.

The spectrometer status indicator can have the following colors: green, yellow and red. These colors indicate the following status conditions of the Spectro-FTIR Alpha.

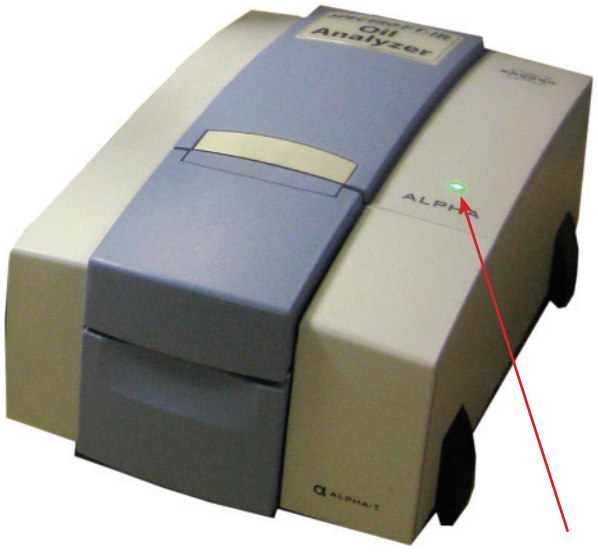


Figure 4.5-1, Spectro-FTIR Alpha Status Light

- **Green** (permanent): Spectrometer is in proper operating condition.
- **Yellow**: Spectrometer is in the initialization phase or it indicates a warning (e.g. IR source has not yet reached its operating temperature, the air humidity content inside the spectrometer is too high etc.)
- **Red**: Spectrometer malfunction, defective spectrometer component.

4.5.3 OPUS Status Light

The status light is in the lower right corner of the OPUS interface, Figure 4.5-2.

The OPUS status light can have the following colors: green, yellow, red and gray. These colors indicate the following spectrometer status:

- **Green** (permanent): Spectrometer is in proper operating condition.
- **Yellow**: Spectrometer is in the initialization phase, or a warning is indicated (e.g. IR source has not yet reached its operating temperature, the validity period of the instrument is expired, the air humidity content inside the spectrometer is too high etc.)
- **Red**: Spectrometer malfunction, defective spectrometer component, performance test / instrument test failed
- **Gray**: In OPUS, no spectrometer is selected or the spectrometer is off or the spectrometer is in stand-by mode.

NOTE: In case of a yellow status light it is still possible to perform analyses. If the status light is red or gray, analyses are not possible. The color of both status lights, in OPUS and on the spectrometer, corresponds in most cases except for one case: if the performance test or the instrument test has failed the OPUS status light is red whereas the spectrometer status indicator lights yellow.

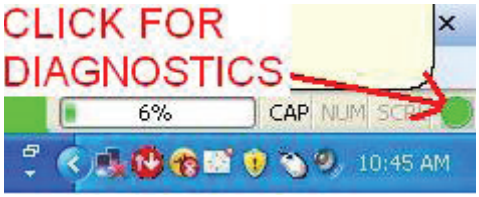


Figure 4.5-2, OPUS Status Light

4.5.4 OPUS Instrument Status Dialog

The OPUS Instrument dialog opens when you click on the status light, Figure 4.5-3.

The status of the hardware components, e.g. source, laser, interferometer, etc. are displayed in the upper icon line. The second row of icons refer to the possible active test channel and indicates the result of the last instrument test performed.

The status for each hardware component can be either Okay, a Warning or an Error.

- **GREEN**: Component is okay (green check).
- **WARNING** (light blue): this status has two possibilities.
  - End of the specified lifetime of a component has almost been reached. Analyses are still possible, but component must be replaced.
  - The source is still warming up (duration is about 7 minutes). Analyses are not possible until indicator changes to green.
- **ERROR (red)**: Component is defective and analyses are not possible.

A fault diagnosis can be performed for each hardware component. To do so, click on the icon of the component that has an ERROR message and the Instrument Status Message, Figure 4.5-4 will appear. The message contains all relevant information on the current operating state of the component. The information on the message can be usefull when troubleshooting with the Spectro Inc. Service Department.

The test results in the second row can be either Passed, Expired or Failed.

- PASSED (green): Instrument passed test and results are still valid.
- EXPIRED (light blue): Instrument test validity period has expire.
- FAILED (red) Instrument test failed.

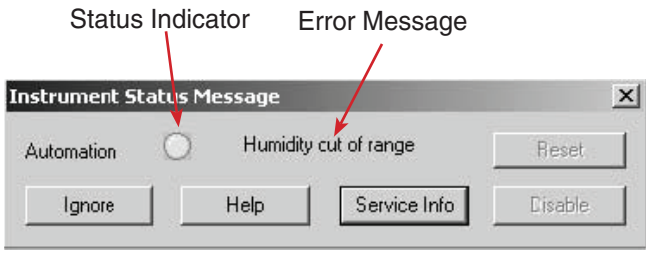


Figure 4.5-4, Instrument Stsatus Message

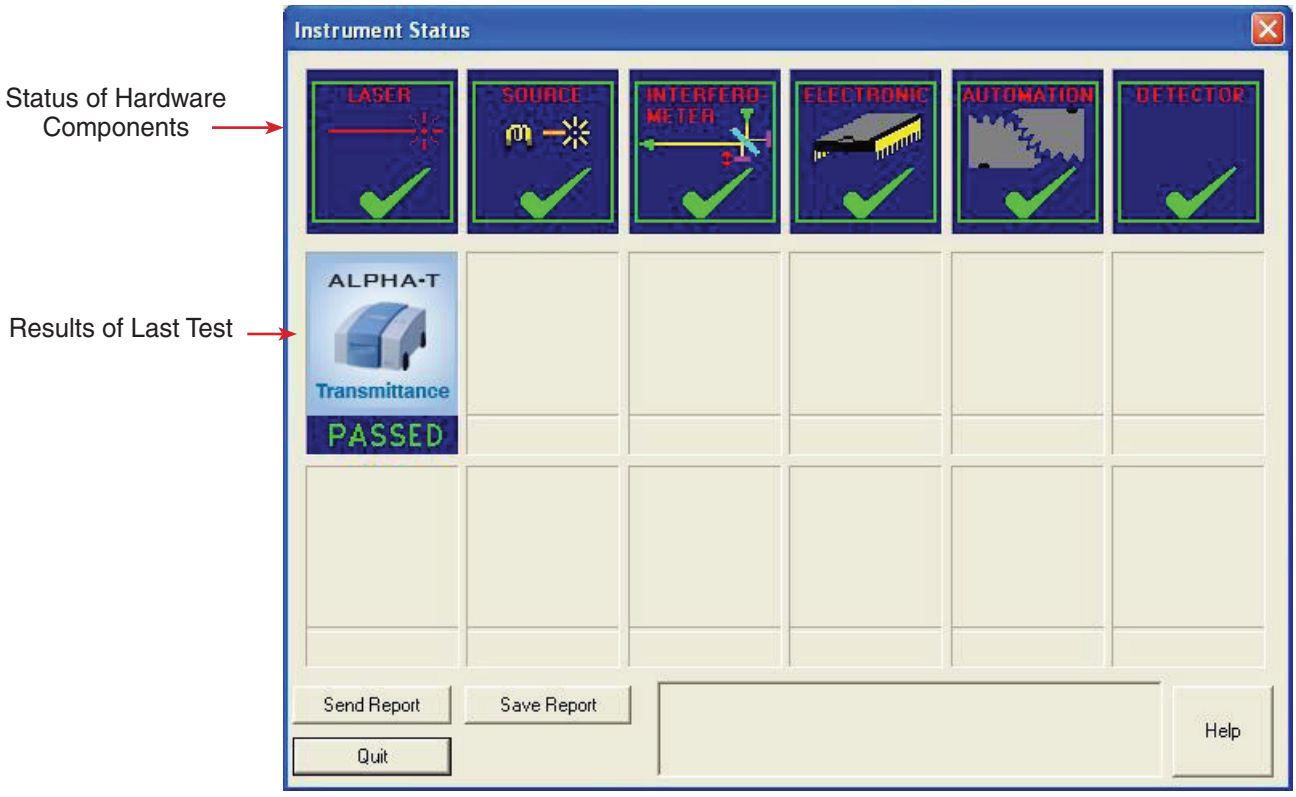


Figure 4.5-3 Instrument Status Dialog

4.5.5 Spectrometer Diagnostic LED's

There are three diagnostic LED's on the rear of the spectrometer, Figure 4.5-5. The LED's indicate the status of the spectrometer's status at a specific during normal operation,

A description of the diagnostic LED's is as follows:

- **TKD Led** - The Take Data led indicates that the interferometer mirror is within the data acquisition range. When data acquisition actually takes place, the light intensity changes to bright green.

- **ACC Led** - The Access led indicates that the network is accessing the spectrometer optics. During transition of measuring data, the led will be light yellow.

- **DIR/ERR Led** - The Direct Error led flashes slightly red during normal operation to indicate scanner movement. If the led is solid bright red, there is an interferometer problem such as no laser signal.

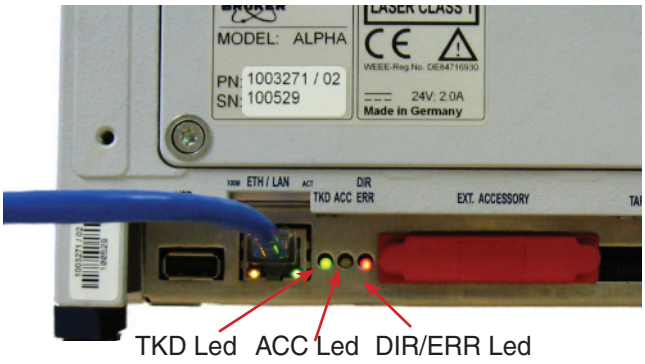


Figure 4.5-5, Diagnostic LED's

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