EasyMatch QC 4.70 and Above
User's Manual

Hunter Associates Laboratory
11491 Sunset Hills Road
Reston, Virginia 20190 USA

www.hunterlab.com

A60-1012-402
Manual Version 2.2

An ISO 9001 Certified Company

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The world's true measure of color
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SOFTWARE VALIDATION STATEMENT

HunterLab's ISO 9001:2008 program details the following requirements for software projects:

- Establishment of performance requirements
- Creation of a project plan
- Development and approval of program requirements
- Design
- Coding
- Design review and approval
- Code archival
- Test plan development (including requirements verification, general quality and performance verification [color calculation and data management and presentation], and sensor interface and performance verification)
- Testing (including requirements verification, general quality and performance verification [color calculation and data management and presentation], and sensor interface and performance verification)
- Documentation and production release.

EasyMatch QC Version 4.0 satisfied these requirements.

LRQA
Business Assurance

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Hunter Associates Laboratory, Inc.
Reston, Virginia, USA

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

Design, Manufacture and Service of
Color Measurement Instruments.

Approval
Certificate No: UQA 0105254

Original Approval: November 11, 1994

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Certificate Expiry: November 12, 2012

Issued by: Lloyd's Register Quality Assurance, Inc.

ANAB ACCREDITED

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Safety Notes

For your safety when using your color measurement equipment, you should pay particular attention to the following types of statements in the hardware section of this User's Manual. Each description is shown in its representative typeface.

Notice: General safety instruction that should be observed at all times while operating the instrument.

CAUTION
Specific safety instruction critical to the type of instrument operation being explained in the area of the manual where the caution appears.

Note: Additional clarification of instructions, not safety-related.

The following symbol indicates that there may be a danger of electric shock from high voltage if the given instructions are not followed carefully.

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Part I. Software Overview

CHAPTER ONE

Introduction to EasyMatch QC

Organization of the EasyMatch QC User's Manual

This manual is comprehensive in that it provides information concerning your color measurement instrument and computer **hardware** (including installation, use, maintenance, and troubleshooting) as well as instructions for use of the EasyMatch QC **software**. Thus, every component of your color measurement **system** is covered.

Software instructions are given in the first two sections of the manual (Chapters 1 - 10) and hardware information is given in the third part of the manual (Chapters 11 and 12). Additional reference information on sample measurement, color scales, terminology, etc. is given in Chapters 13, 14, and the appendices.

What is EasyMatch QC?

EasyMatch QC is a comprehensive color quality control package designed for 32-bit Windows (Windows 2000 and higher). The software allows you to control your spectrophotometer instrument, make color measurements, and display, print, and store results, both in spreadsheet format and graphically.

The basic features of EasyMatch QC are discussed in the rest of this chapter, lessons helping you learn to use those features are given in Chapter 2, and the various software menus are explained in chapters 3 through 10.

Features

The sections below examine some of the most important concepts and features related to operation of EasyMatch QC.

Jobs

A job is a collection of all the data views (displays) and measurements (standards and samples) that you use for a particular task, product, or customer. Jobs are the "documents" of EasyMatch QC, analogous to word processing documents containing text and its formatting or spreadsheet documents containing fields of data and formulas. If you wanted to transfer a job to another computer or another user who also has EasyMatch QC, the job file (with a .JSD file extension) would contain all the information needed to examine and/or reproduce your results.

You can create new jobs for many different reasons, such as to hold data for a certain customer or a specific product line. Each operator may maintain his own job with his own preferences, or you can create separate jobs for different operations, such as measuring plastic pellets before extrusion and then the final extruded product. You can be creative in maintaining and organizing your job files.

You may have multiple jobs open and in use at the same time; each job will be shown as a separate tab on your screen. You can switch easily between jobs by clicking the tab of the job you wish to see.

To set up a job, you will need to complete the following tasks:

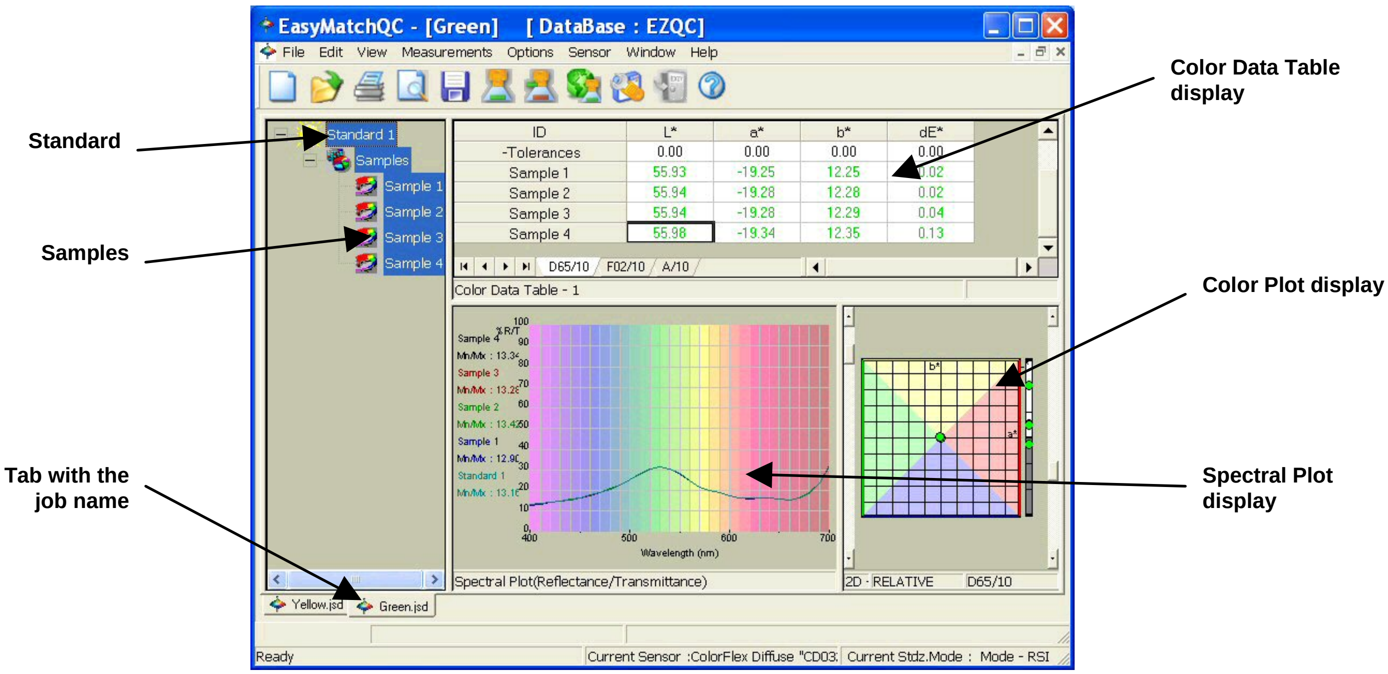
1. Open the new job.

2. Save the job under the desired name. (Long file names and spaces are acceptable.)

3. Configure the desired data views (see the "Data Views" section), including setting the location, size, shape, and properties of each view on the screen.

4. Read or recall the desired standard and samples into the job and view the results. The number of standards and samples that can be housed in a single job is virtually unlimited—restricted only by the amount of memory available on the computer.

It is difficult to "picture" a job file, but a screen capture of a job is provided below as an illustration.



As you can see on the tab, this job is called "Green." You can see that the job contains a standard called "Standard 1" and four numbered samples. A 2D Color Plot has been configured to display the CIELAB color scale for D65/10° with a colored background. The Color Data Table display is displaying L*, a*, b*, and dE* for the samples related to the standard. The Spectral Plot is displaying spectral reflectance at 10 nm increments with the colored background. The location, size, and shape of each view are also saved as part of the job, along with the measurements and the properties of each view.

A second job, called "Yellow," is contained on the tab behind this one and you can switch to it simply by clicking the tab at the bottom of the screen.

Job Conventions

Although great flexibility has been incorporated into the concept of a job, there are some attributes that all jobs will share.

- Each individual job may contain all the information necessary to complete that job if the operator has included that data. All information recalled from the database or read in through the instrument for use in that job will be saved with that job.

- When you recall a job, it will reappear looking exactly the same as when it was last closed.

Note: It is recommended that you back up your database, job, and template files periodically, particularly prior to upgrading or making other major changes to your system computer.

Templates

Job templates can be thought of as subsets of jobs. They contain some of the pieces of information contained in jobs, but not all of them. Templates are analogous to "style lists" or "style sheets" that are available in some word processing and desktop publishing programs because they can be used to control the cosmetic appearance of a job. A template houses configuration information for the data views and screen, such as locations, sizes, shapes, and properties, but does not contain any measurements. A template is saved whenever a job is saved.

A template is meant to be used as a starting point in creating a new job when the same views are used for many jobs. You can then "fill" the template with measurements and configuration settings. Several application-specific templates are installed with EasyMatch QC. These templates provide a starting point for new jobs.

To set up a template, you will need to complete the following tasks:

1. Open a new job.

2. Configure the desired data views. This includes setting the location, size, shape, and properties of each view on the screen.

3. Configure the desired options you wish to use for this template using the **Options** menu.

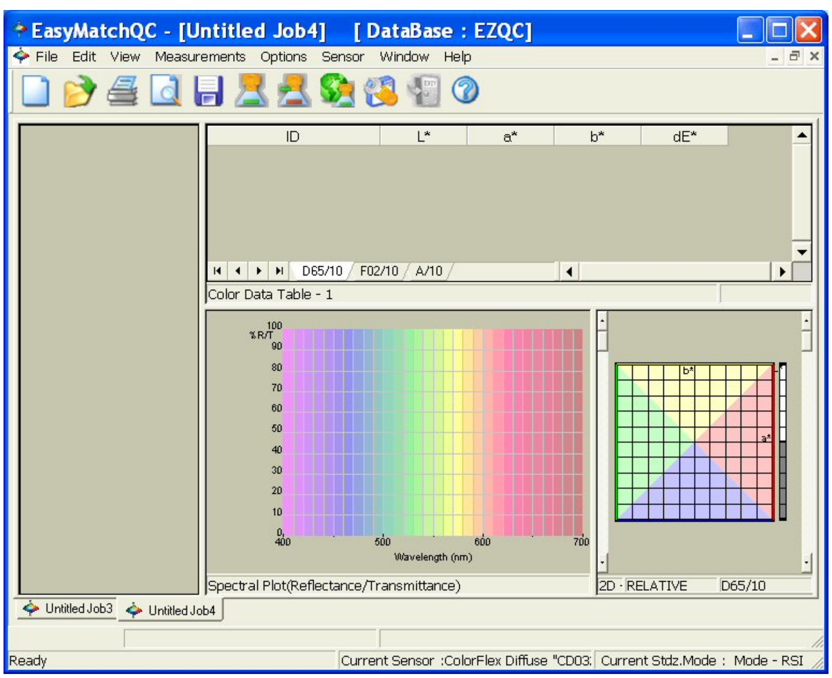
4. Save the job as a template using the **Save Job Template As** command in the **File** menu. The extension for a template is .JTP.

More instructions on creating and working with templates are provided in Lesson 1 in the next chapter.

Whenever you want to use a template to create a new job, simply choose the **Open Job Template** command from the **File** menu, choose the desired template from the list of available templates, fill the template with your measurements, and save it as a job.

To apply a template to an existing job, choose the **Apply Template to Job** command from the **File** menu and the configuration of the job screen will adjust to match the template while retaining the measurements.

The types of information a template may house are illustrated in the picture below.



Templates contain no standards or samples. The measurements would be added to the job as they are made. The screen configuration and options for each data view comprise the template and will be part of any job created using the template.

There are four menu options allowing you to utilize templates: **Open Job Template**, **Save Job Template**, **Save Job Template As**, and **Apply Template to Job**. These menu options are described fully in Chapter 3.

> *Note: It is recommended that you back up your database, job, and template files periodically, particularly prior to upgrading or other major changes to your system computer.*

Data Views

Each of the smaller panes shown on a job tab is a data view. Each data view displays unique information about the standard and/or samples. You may resize any data view to fill as much or as little of the screen as you like.

The types of data views that are available are:

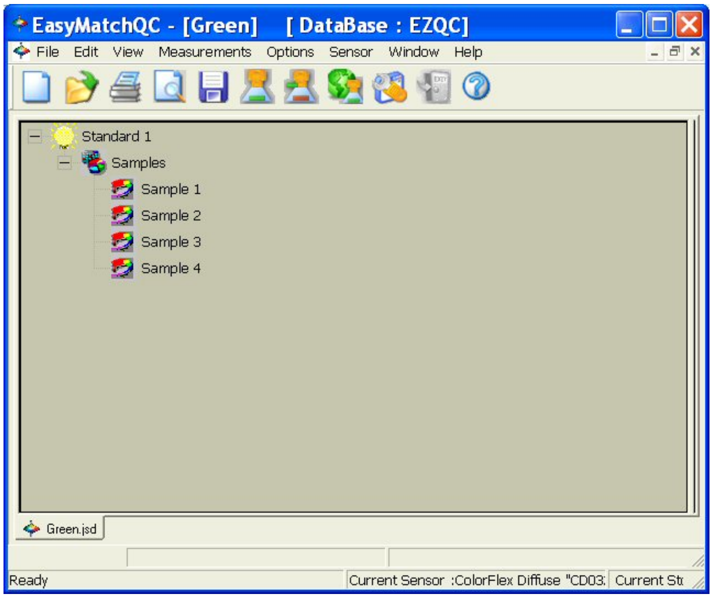
- Job Tree
- Color Data Table
- 2D Color Plot
- 3D Color Plot
- Color Render
- EZ View
- Memo View
- Spectral Data Table
- Spectral Plot
- Trend Plot.

These views are described in the subsections below. More instructions on configuring data views are provided in Lesson 1 in the next chapter.

Job Tree

The information displayed in the Job Tree view includes the name of each standard and each sample contained in the job. Samples affiliated with a particular standard will be shown as branches under the standard.

*Note: The Job Tree is only visible when **Job Tree** is checked in the **View** menu.*



Single or multiple items may be highlighted in this view. Click the "+" next to an item to open the branches below it or the "-" sign to close the branches. Click the left mouse button on any item to highlight it. To highlight multiple items, hold the **Ctrl** key while clicking on each desired item or hold the **Shift** key and click on the first and last items desired to highlight all items in between. Then click the right mouse button for various options concerning the highlighted items. These options are described below. In addition, the items that are highlighted in the Job Tree are those displayed in the other views in the job.

Note: To keep data views clean and not cluttered, and for speed of measurements, it is recommended that you limit the number of items highlighted in the Job Tree at any one time to 500 or less.

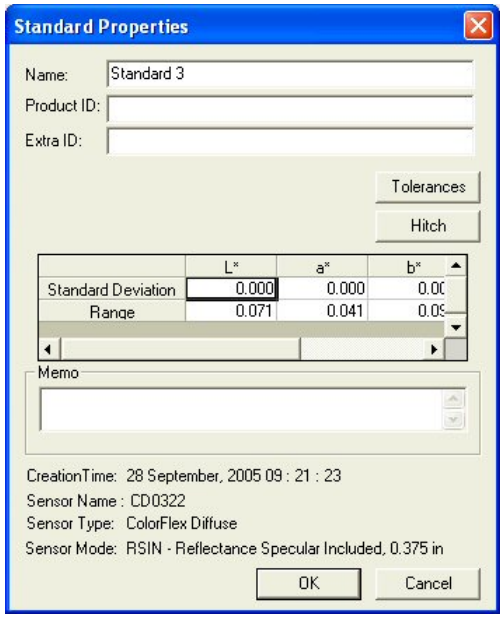
- **Cut:** This command removes the highlighted items from the Job Tree and from the job and places them on the Windows clipboard. If desired, the cut items may then be pasted into another job using the **Paste** command.

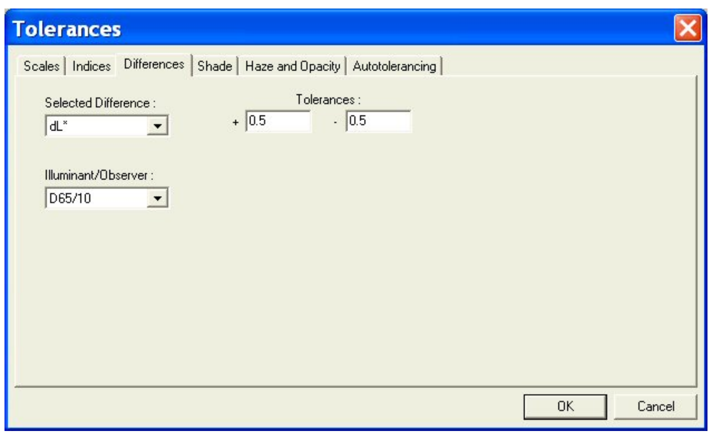
- **Copy:** This command copies the highlighted items from the Job Tree to the Windows clipboard. If desired, the copied items may then be pasted into another job using the **Paste** command. Items may also be dragged and dropped from one job to another in order to copy and then paste them.

- **Paste:** This command allows you to place items previously cut or copied to the Windows clipboard onto the Job Tree and into this job. Items may also be dragged and dropped from one job to another in order to copy and then paste them.

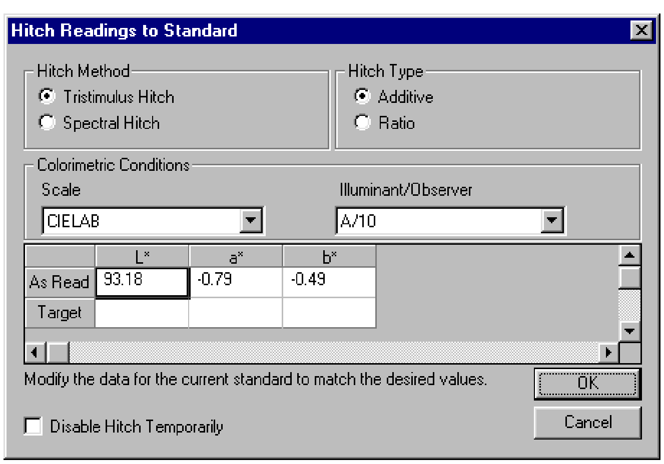
- **Delete:** This command allows you to **permanently** delete the currently highlighted items from the Job Tree and from the job. **No copies of the items are kept on the Windows clipboard.**

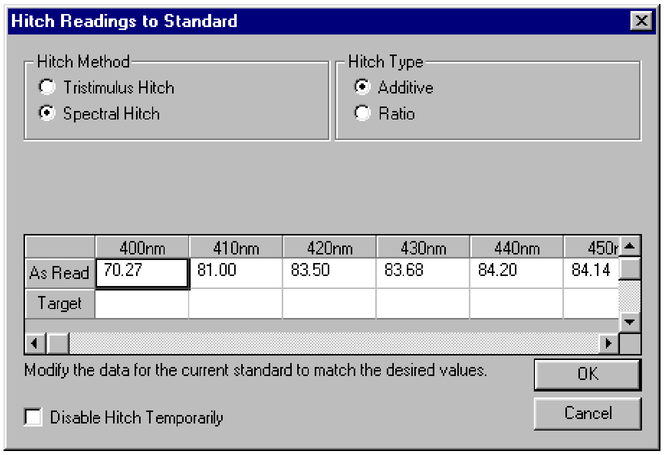
- **Properties:** This command allows you to view the measurement properties of the currently highlighted item. If the standard or sample is the result of averaging several readings, the standard deviation and range of those readings are included. For standards, you may also set tolerances for as many scales, indices, and differences in as many illuminant/observer combinations as you wish and/or indicate hitch factors to apply to the standard and its samples.





See the "Default Tolerances" section in the Options Menu chapter for instructions on setting tolerances. More instructions on entering tolerances are also provided in Lessons 3 and 7 in the next chapter.





See Lesson 5 in the next chapter for detailed instructions on using a hitch standard.

- **Show This Item Only:** This command appears for standards only and causes the chosen standard and its associated samples alone to be displayed in the Job Tree. All other standards and samples are removed from the Job Tree display.

- **Copy Sample To Standard:** This command appears for samples only and causes the highlighted sample measurement to replace the current standard measurement in the Job Tree, while retaining the sample's ID.

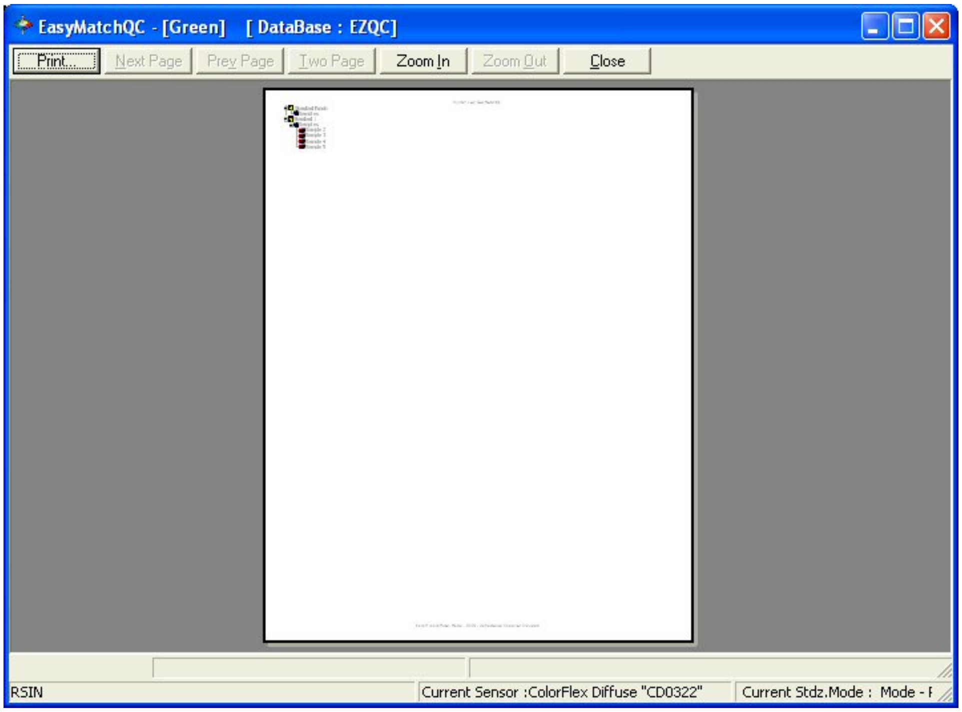
- **Copy Sample to New Standard:** This command appears for samples only and causes the highlighted sample measurement to be added to the job as a standard as well, while retaining the sample's ID.

- **Copy Standard To Sample:** This command appears for standards only and causes the highlighted standard measurement to be placed in the Job Tree as a sample on that standard's branch. You are given the opportunity to name the new sample.

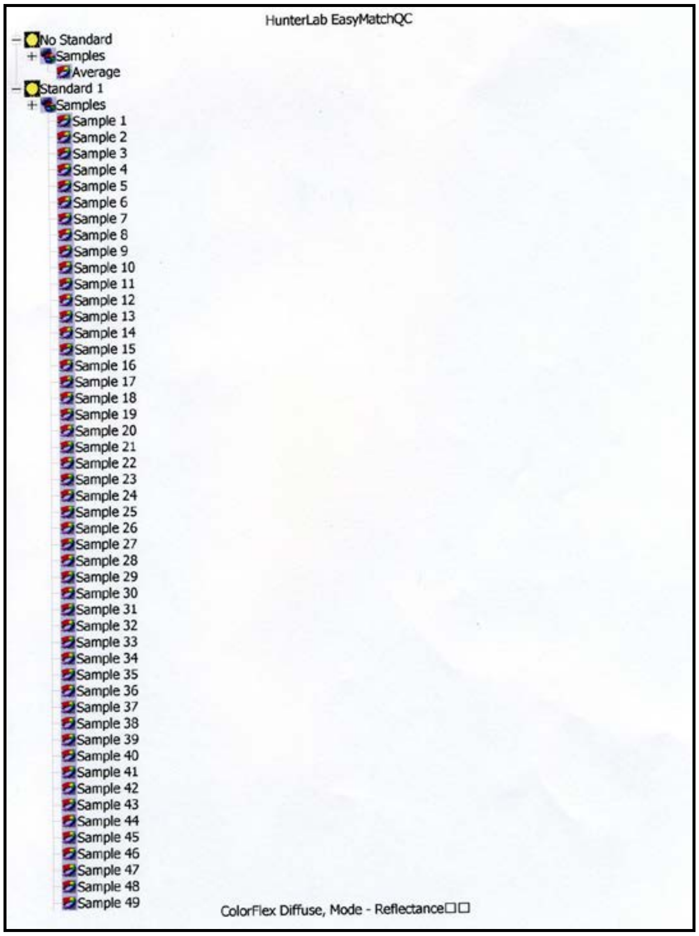
- **Copy Standard To New Standard:** This command appears for standards only and causes the highlighted standard measurement to be added to the job as a second instance of the standard, while retaining the original standard's ID.

When the right mouse button is clicked on an open area of the Job Tree view (an area other than a sample or standard), further commands are available, as follows:

- **Print Preview:** This command shows on-screen what the Job Tree will look like when printed.



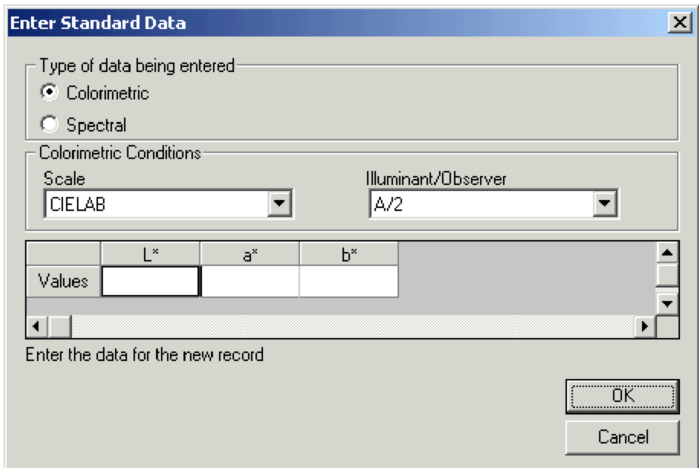
- **Print this View:** This command prints the Job Tree view in a fashion similar to that shown below.

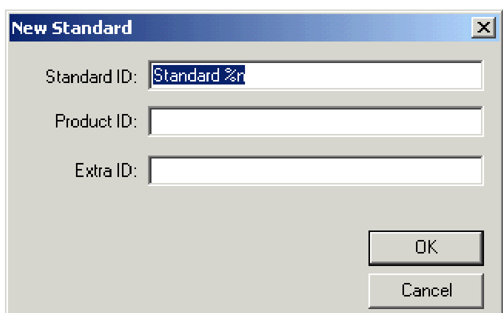


- **Icon Sizes:** Choosing this command allows you to choose to display small icons, large icons, or no icons to represent each standard and sample in the Job Tree.

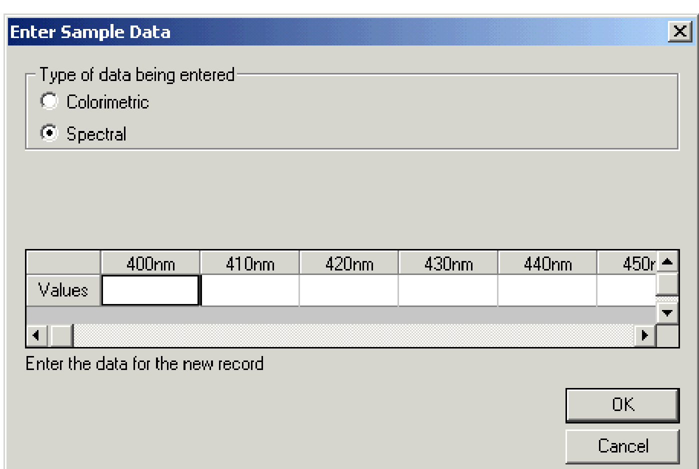
- **Show All Items:** This command opens all the branches of the Job Tree so that every standard and sample is visible.

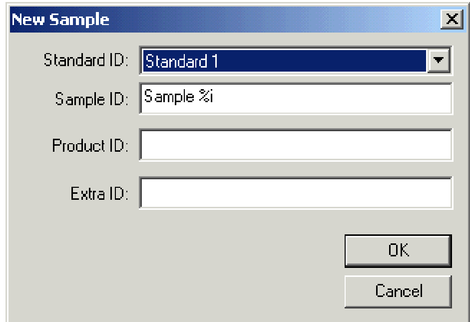
- **Enter Standard Data**: This command allows you to hand enter colorimetric or spectral data to create a new standard. More instructions on using this command are provided in Lesson 3 in the next chapter.





- **Enter Sample Data:** This command allows you to hand enter colorimetric or spectral data to create a new sample.





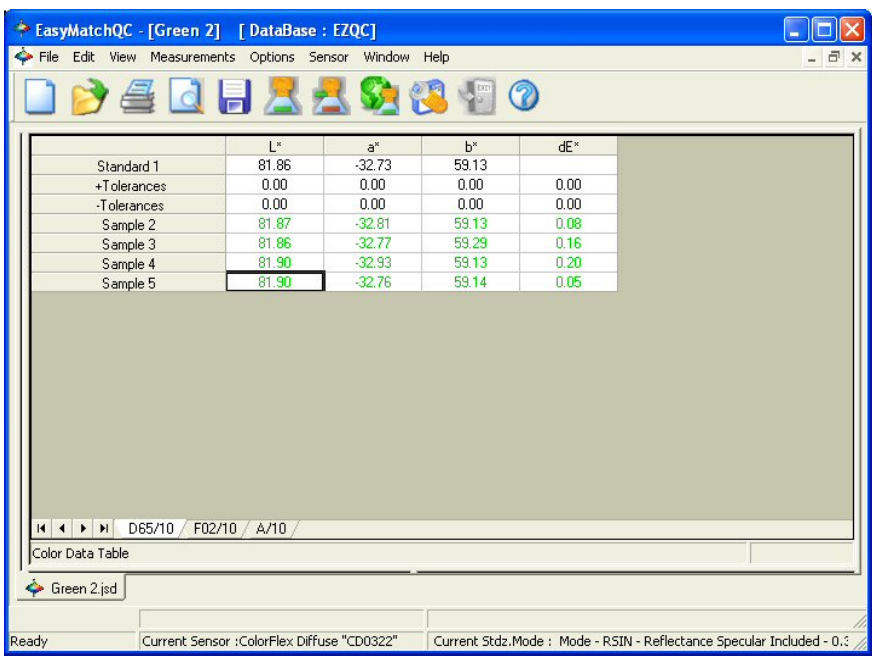
- **Collapse the tree:** This command closes all the branches of the Job Tree so that only the standards are visible.

- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.

- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

Color Data Table

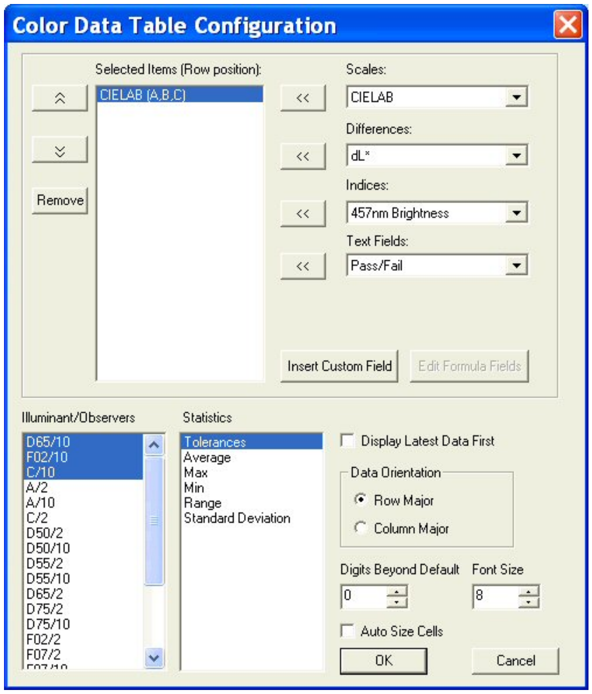
The Color Data Table view shows color scale, color difference, and index data for the standards and samples in the job. The items in the Color Data Table may be sorted by clicking the column header (for row major) or row header (for column major) of interest.



Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Copy to Clipboard:** Before you initiate this command, you must highlight one or more of the samples and standards shown in the spreadsheet. When **Copy to Clipboard** is then selected, the highlighted data is then copied to the Windows Clipboard. If desired, the copied data may then be pasted into another application (such as Microsoft Excel) using its **Paste** command.

- **Configure:** This command allows you to set various preferences pertaining to the Color Data Table view.



Select each scale, difference, index, and text field parameter you would like to display from the drop-down boxes and click the left arrow (<<) button after each selection to move it to the Selected Items box. Once all desired items are shown in the Selected Items box, you may move them up and down in the display order using the up and down arrows. Items may also be removed from the Selected Items box using the **Remove** button.

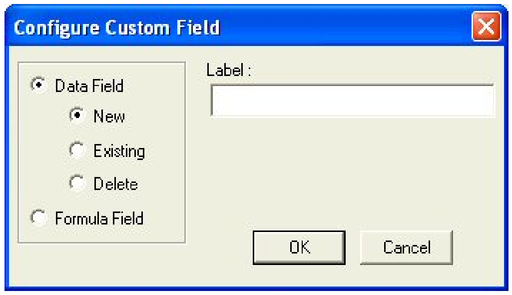
Highlight (select) each illuminant/observer combination you wish to display. Choose your statistics the same way. You may indicate the order in which you would like the illuminant/observer tabs and statistical parameters displayed by deselecting all items that have already been chosen and then selecting the items for display in the order desired.

Configure other settings at the bottom right of the screen. When Display Latest Data First is checked, the most recent reading is shown at the top of the display rather than the bottom. When Auto Size Cells is checked, the spreadsheet cells will be automatically sized based on the data contained in them.

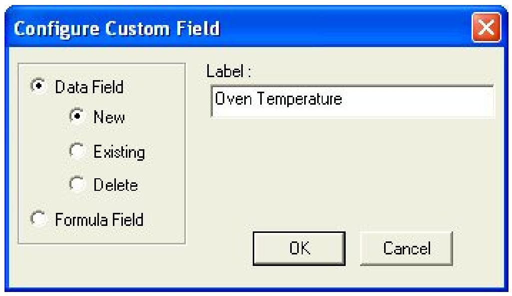
You may also insert custom fields into the Color Data Table using the **Insert Custom Field** button. These fields may consist of data obtained from outside EasyMatch QC or calculated formulas. Follow the instructions below to insert a custom field. More detailed instructions are also provided in Lesson 8 in the next chapter.

Custom Data Field

1. Click **Insert Custom Field**. The Configure Custom Field box appears.



2. Click the radio button next to Data Field and then the radio button next to New. Type a label for the data field into the Label box. In this example, "Oven Temperature" was used.

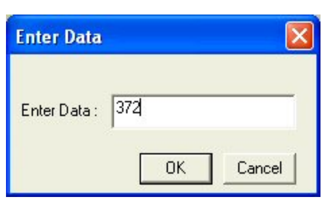


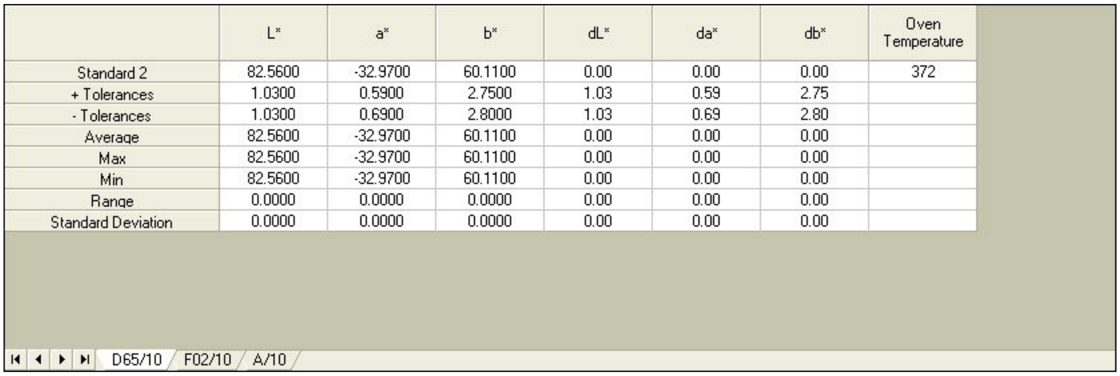
3. Click **OK**. Add "Data Fields" to your display as a text field, then click **OK** from the Color Data Table Configuration screen. The Oven Temperature field is added to the Color Data Table.

	L*	a*	b*	dL*	da*	db*	Oven Temperature
Standard 2	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
+ Tolerances	1.0300	0.5900	2.7500	1.03	0.59	2.75	
- Tolerances	1.0300	0.6900	2.8000	1.03	0.69	2.80	
Average	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Max	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Min	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Range	0.0000	0.0000	0.0000	0.00	0.00	0.00	
Standard Deviation	0.0000	0.0000	0.0000	0.00	0.00	0.00	

D65/10 / F02/10 / A/10

4. Enter the oven temperature for each item desired by right-clicking on the item in the Job Tree and selecting **Enter Oven Temperature Data** from the menu that appears. ("Oven Temperature" will be replaced by whatever label was entered on the Configure Custom Data screen.) Once you click **OK**, the entered data will be displayed.

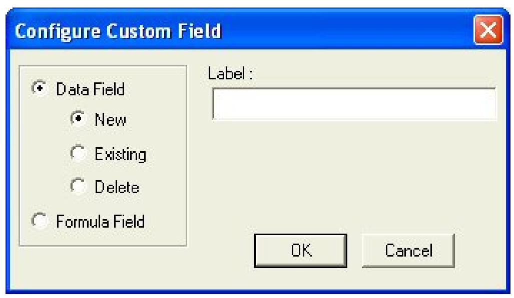




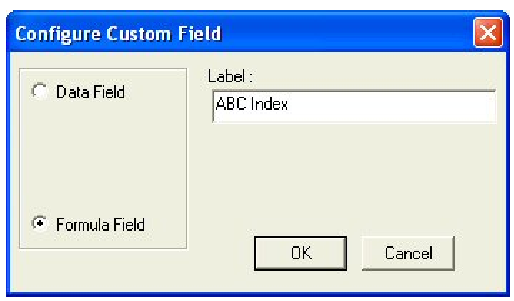
	L*	a*	b*	dL*	da*	db*	Oven Temperature
Standard 2	82.5600	-32.9700	60.1100	0.00	0.00	0.00	372
+ Tolerances	1.0300	0.5900	2.7500	1.03	0.59	2.75	
- Tolerances	1.0300	0.6900	2.8000	1.03	0.69	2.80	
Average	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Max	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Min	82.5600	-32.9700	60.1100	0.00	0.00	0.00	
Range	0.0000	0.0000	0.0000	0.00	0.00	0.00	
Standard Deviation	0.0000	0.0000	0.0000	0.00	0.00	0.00	

Custom Formula Field

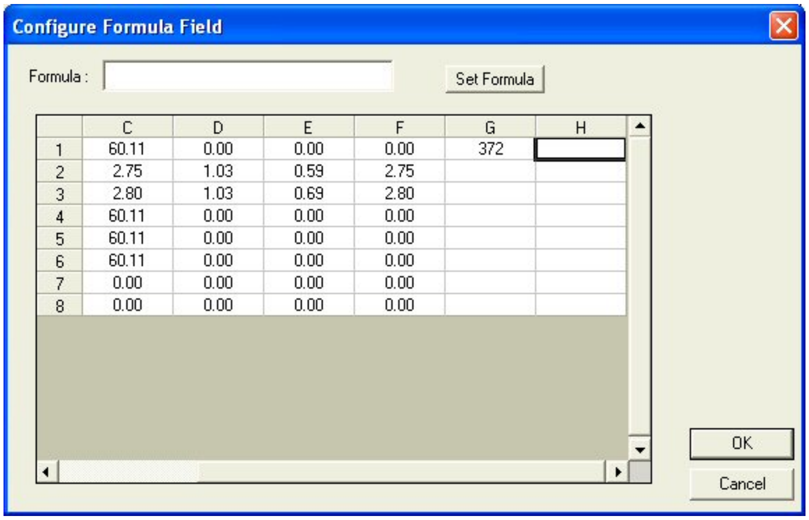
1. Click **Insert Custom Field**. The Configure Custom Field box appears.



2. Click the radio button next to Formula Field. Type a label for the formula field into the Label box. In this example, "ABC Index" was used.



3. Click **OK**. The Configure Formula Field box is shown.

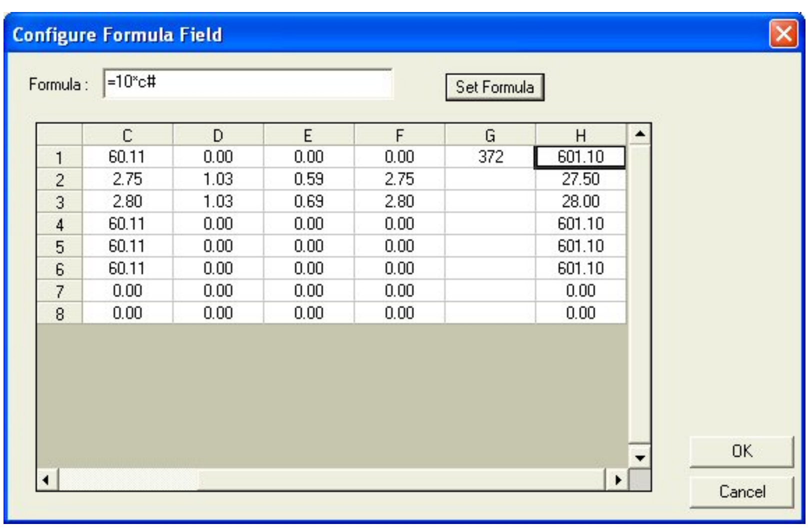


4. The outlined cell represents where your custom field will be inserted. Place your cursor in the Formula box at the top of the screen and type "=" (equals).

5. Type the formula. Further information follows.

   A formula is a text string defining how the value of the cell is to be calculated. Only cells containing numeric data may be referenced in a formula. A cell is referenced in a formula by specifying the column letter and then the row number. The columns are counted as A to Z from left to right of the spreadsheet. The rows are numbered from 1 to n from the top of the spreadsheet down. For instance, the top left cell of the spreadsheet is "A1." You may use the pound sign (#) instead of a column letter or row number to indicate that you wish to use the same row or column as the cell containing the formula. For instance, in the example below, "C#" indicates that the same formula will apply to each cell of the column in which the formula was entered, using the data from Column C's cell in the same row. It is useful to specify formulas in this manner if you want to assign formulas to entire rows or columns.

Note: The row or column letter or number for each parameter selected in the Color Data Configuration was shown after that parameter in the Selected Items box.



The operators you may use in your formulas are:

+	Addition
-	Subtraction
^	Power operator
*	Multiplication
/	Division
&	Logical And
|	Logical Or
!	Negation
>	Greater than
<	Less than
=	Equality
:	Sum a range of cells.

Use parentheses as necessary to indicate the desired order of operations.

The functions you may use in your formulas include:

ABS(Coord)	Returns the absolute value of the cell.
ADD(a,b)	Adds the two elements.
ACOS(Coord)	Returns the arccosine of the value in the cell
ASIN(Coord)	Returns the arcsine of the value in the cell
ATAN(Coord)	Returns the arctangent of the value in the cell
AVERAGE(a:b)	Averages the range of cells
COS(Coord)	Returns the cosine of the value in the cell
EXP(X)	Returns e raised to the power X
IF(a,b,c)	If a is true, cell is assigned b, else assigned c.
LOG10(Coord)	Returns the logarithm (base 10) of the value in the cell
LN(Coord)	Returns the natural logarithm of the value in the cell
MAX(a:b)	Returns the largest of the cell values
MEDIAN(a:b)	Returns the median of the cell values
MIN(a:b)	Returns the smallest of the cell values
NEG(Coord)	Returns the negative of the value in the cell.
NOT(Coord)	Returns the logical NOT of the cell's value
PI	Pi (3.14159...)
POWER(B, P)	Returns base B raised to power P
RADIAN(Coord)	Converts the value in the cell from degrees to radians
SIN(Coord)	Returns the sine of the value in the cell
SQRT(Coord)	Returns the square root of the value in the cell
SQUARE(Coord)	Returns the square of the value in the cell
STDEV(a:b)	Returns the standard deviation of the range of cells
TAN(Coord)	Returns the tangent of the value in the cell.

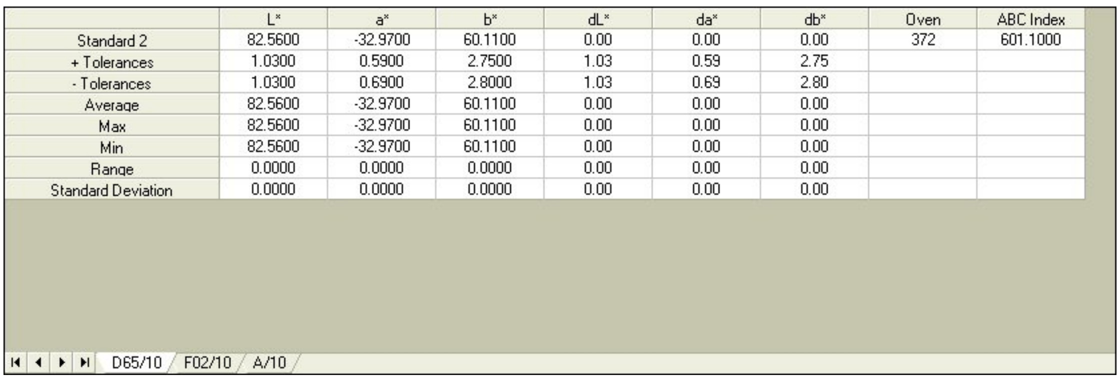
Following are examples of valid formulas.

A1:A10	Sums the first column, rows 1 through 10.
3.1415*C6	Pi times the value in C6.
A#*G#	The cell in column A, this row, multiplied by the value of

	the cell at Column G, same row.
(A1+B1)*C1	Adds the first two cells and multiplies the result by the third.
IF(A1>5, A1*2, A1*3)	If the contents of A1 are greater than 5, then multiply A1 by 2, else multiply A1 by 3.

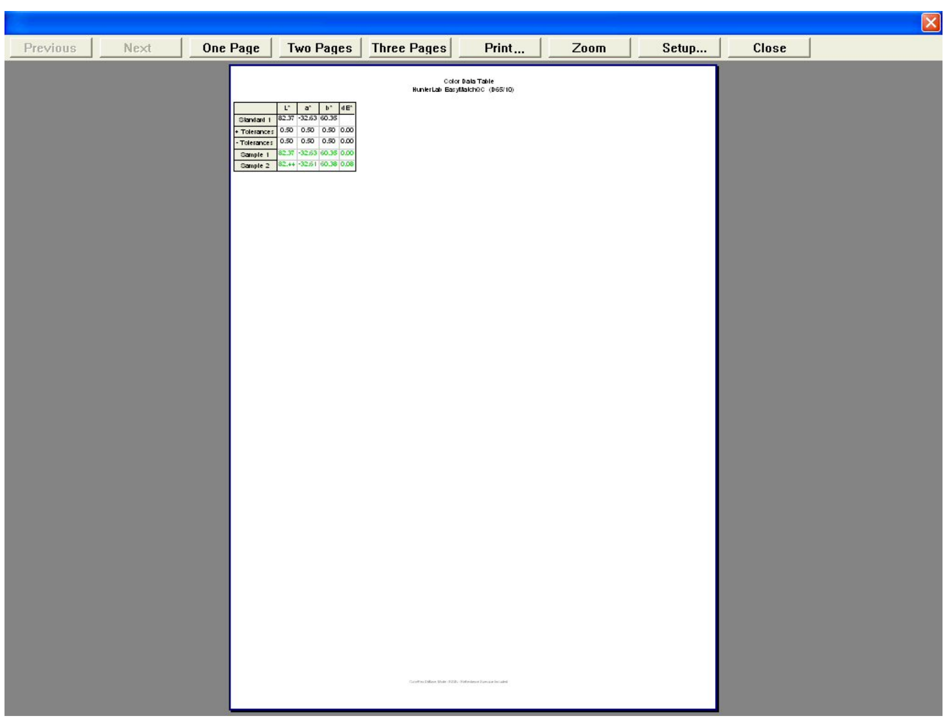
Remember that your formulas are based on cell location, NOT the value in the cell (i.e., your formula uses cell C1, regardless whether L, a, or b values are in it.) If you reconfigure your display, you may need to adjust your formula.

6. Click **Set Formula**, then **OK.** Add "Formula Fields" to your display as a text field, then click **OK** from the Color Data Table Configuration screen. The formula will fill cells as indicated.

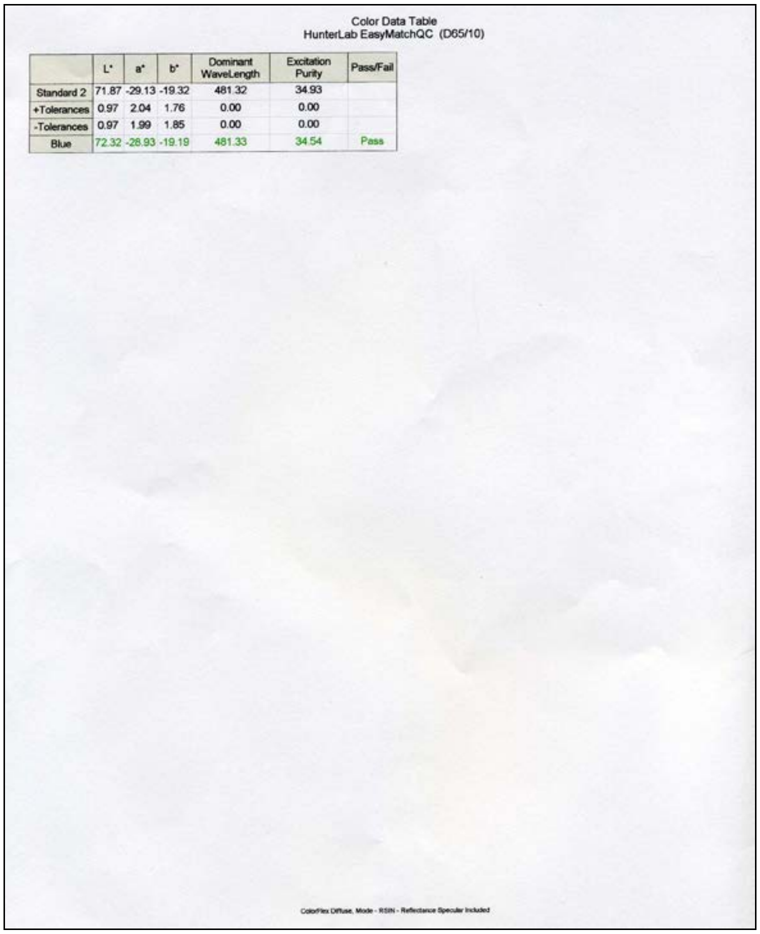


	L*	a*	b*	dL*	da*	db*	Oven	ABC Index
Standard 2	82.5600	-32.9700	60.1100	0.00	0.00	0.00	372	601.1000
+ Tolerances	1.0300	0.5900	2.7500	1.03	0.59	2.75		
- Tolerances	1.0300	0.6900	2.8000	1.03	0.69	2.80		
Average	82.5600	-32.9700	60.1100	0.00	0.00	0.00		
Max	82.5600	-32.9700	60.1100	0.00	0.00	0.00		
Min	82.5600	-32.9700	60.1100	0.00	0.00	0.00		
Range	0.0000	0.0000	0.0000	0.00	0.00	0.00		
Standard Deviation	0.0000	0.0000	0.0000	0.00	0.00	0.00		

- **Print Preview:** This command shows on-screen what the Color Data Table will look like when printed.



- **Print this View:** This command prints the Color Data Table view in a fashion similar to that shown below.



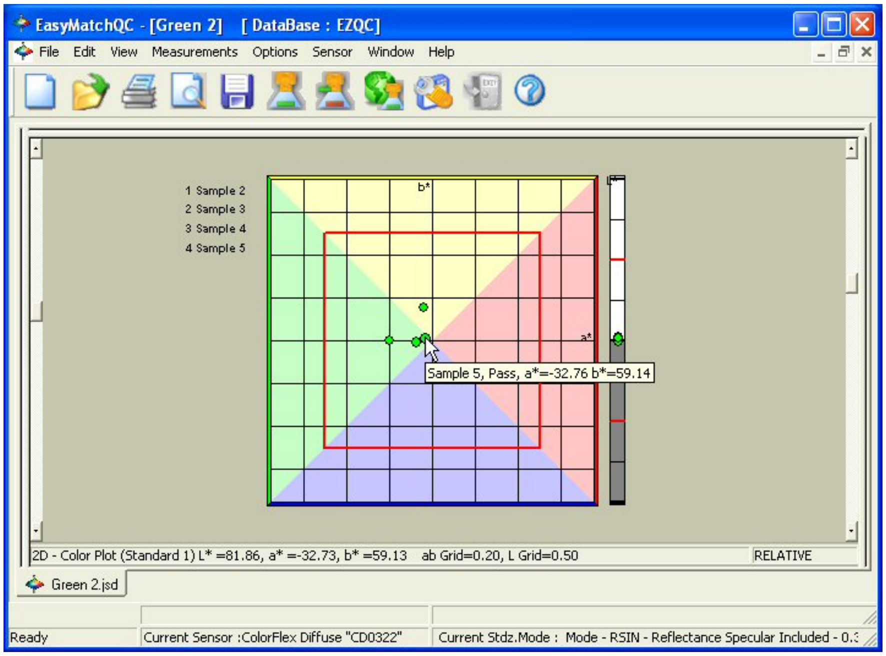
Color Data Table
HunterLab EasyMatchQC (D65/10)

	L*	a*	b*	Dominant WaveLength	Excitation Purity	Pass/Fail
Standard 2	71.87	-29.13	-19.32	481.32	34.93	
+Tolerances	0.97	2.04	1.76	0.00	0.00	
-Tolerances	0.97	1.99	1.85	0.00	0.00	
Blue	72.32	-28.93	-19.19	481.33	34.54	Pass

- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

2D Color Plot

The 2D color plot displays a two-dimensional representation of color space with the standard as the center point of the plot and the samples plotted on the graph. In the example below, the "a*" of the L*a*b* scale is plotted on the x axis and the "b*" of L*a*b* is plotted on the y axis. Just to the right of this square portion of the plot is a "thermometer" graph that plots L*. The samples in the job are shown on the plot relative to the standard and each other. If tolerances have been set, the tolerance limits will be shown as a red box (for rectangular tolerances), ellipse (for elliptical tolerances), or "pie segment" (for polar tolerances) around the standard position. Placing the mouse over a particular point causes the sample ID, its pass or fail status, and its color values to be displayed.

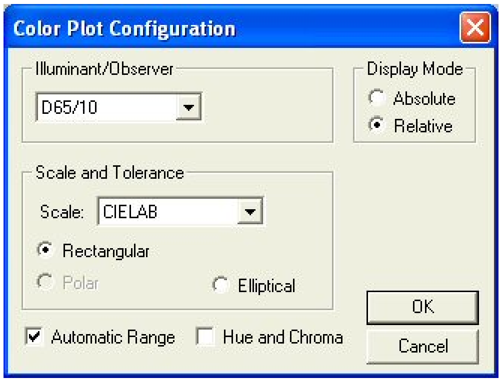


Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Show Background:** This item, when checked, causes the colored background to be shown on the 2D Color Plot. When unchecked, the background is white.

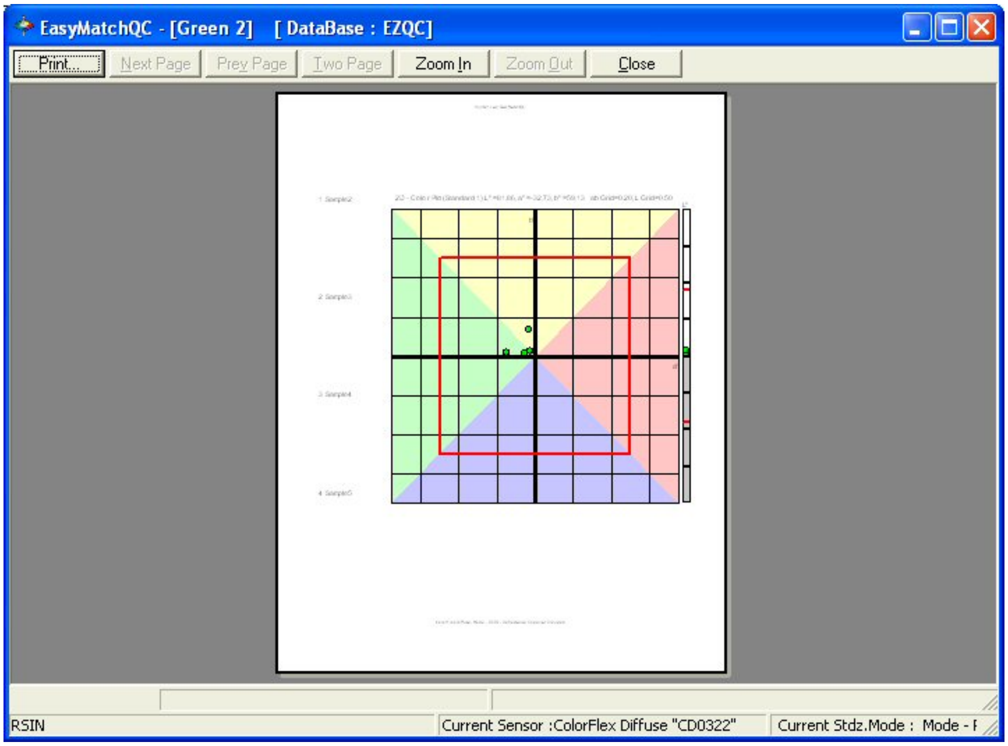
- **Show Legend:** This item, when checked, causes the legend (the list of which samples are currently displayed) to be shown to the left of the 2D Color Plot. When unchecked, the legend is not shown.

- **Configure:** This command allows you to set various preferences pertaining to the 2D Color Plot view.

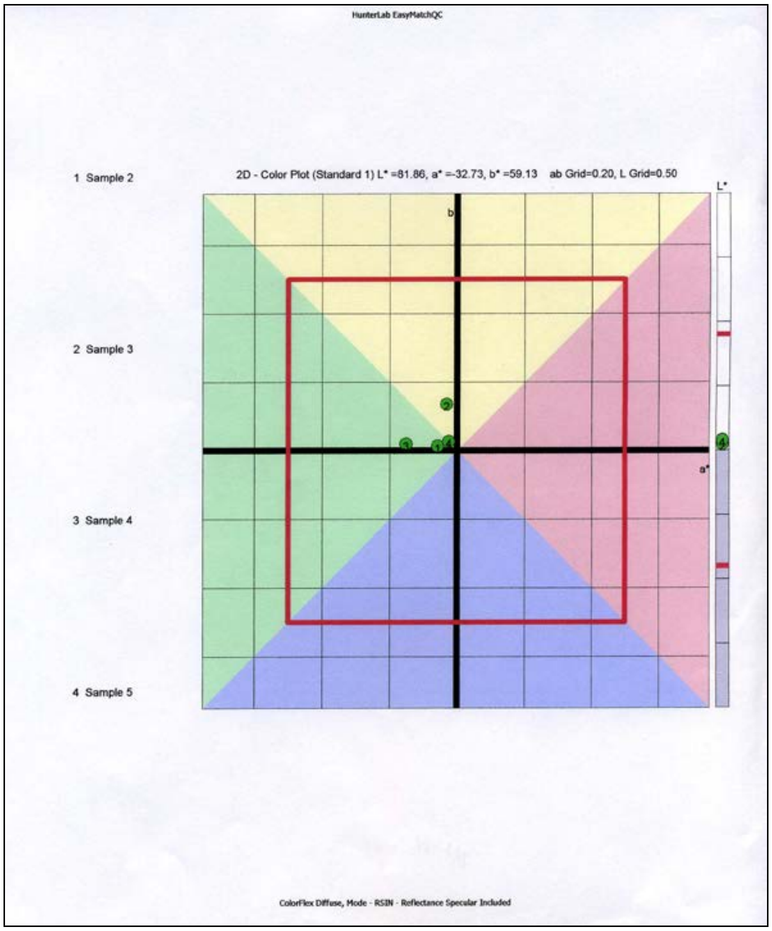


Make your selections for each parameter, including the illuminant, observer, and color scale for display and the whether the hue circle and chroma line should be displayed.

- **Print Preview:** This command shows on-screen what the 2D Color Plot will look like when printed.



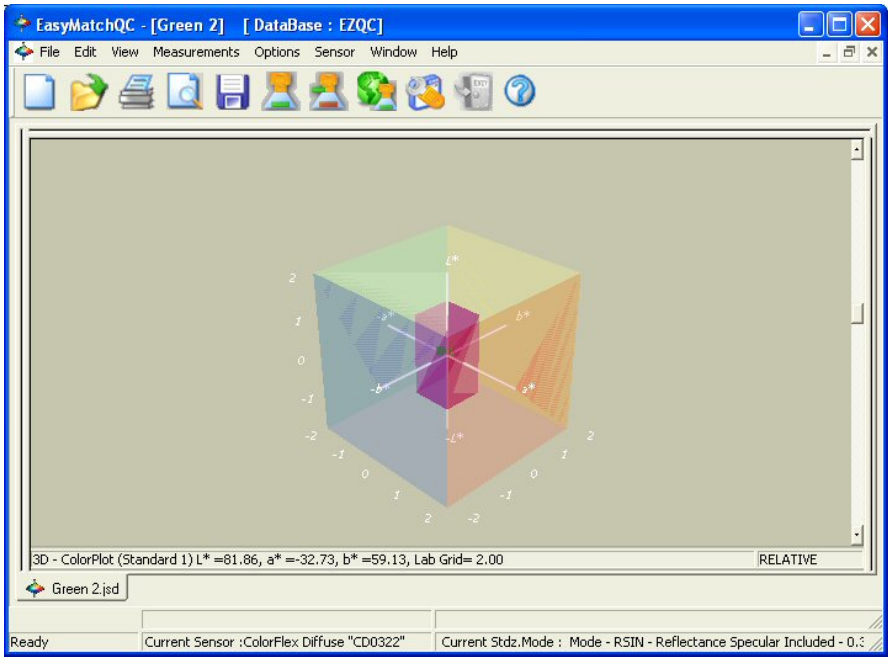
- **Print this View:** This command prints the 2D Color Plot view in a fashion similar to that shown below.



- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

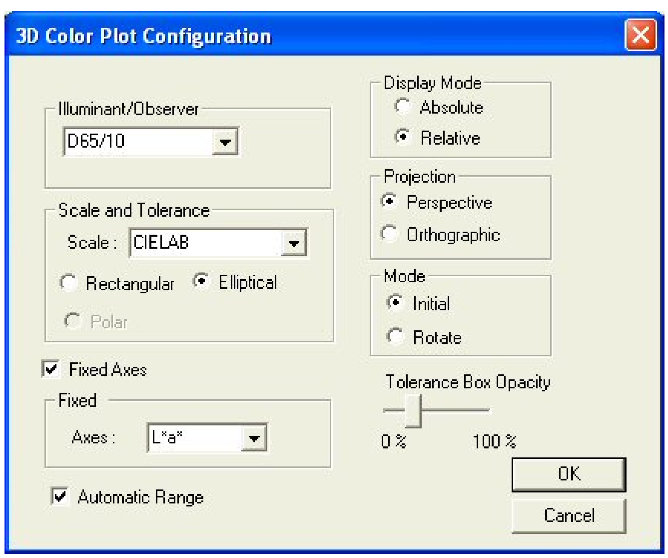
3D Color Plot

The 3D color plot displays a three-dimensional representation of color space with the standard as the center point of the plot and the samples plotted on the graph. In the example below, L*, a*, and b* are shown on the axes as labeled. The samples in the job are shown on the plot relative to the standard and each other. If tolerances have been set, the tolerance limits will be shown as a magenta box (for rectangular tolerances), ellipsoid (for elliptical tolerances), or "pie segment" (for polar tolerances) around the standard position.



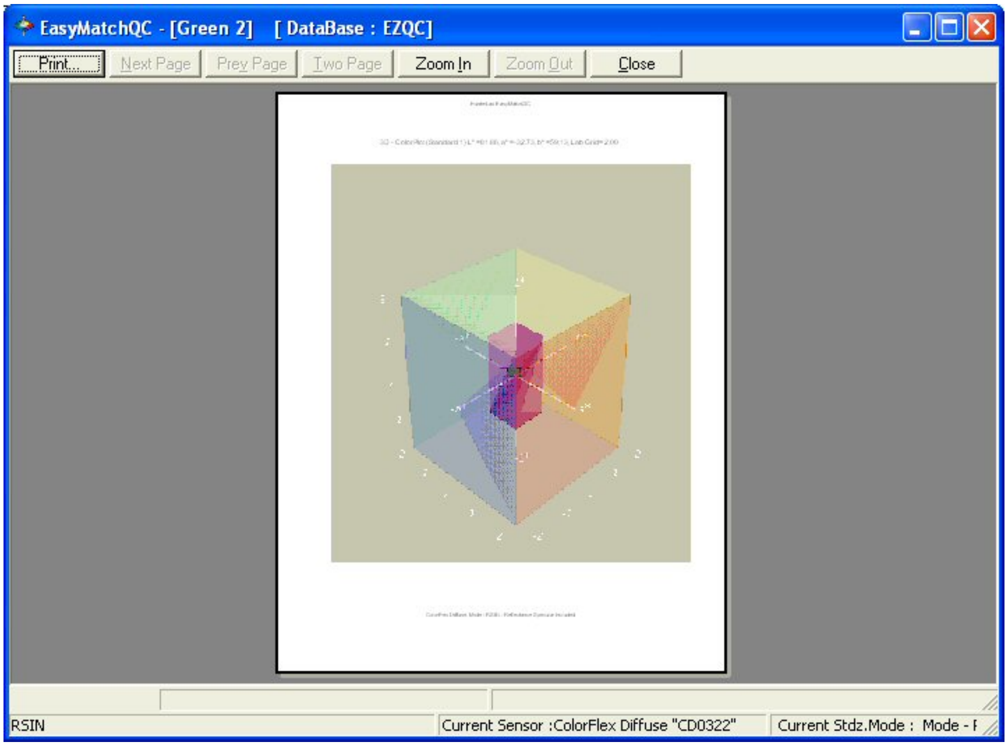
Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Configure:** This command allows you to set various preferences pertaining to the 3D Color Plot view.

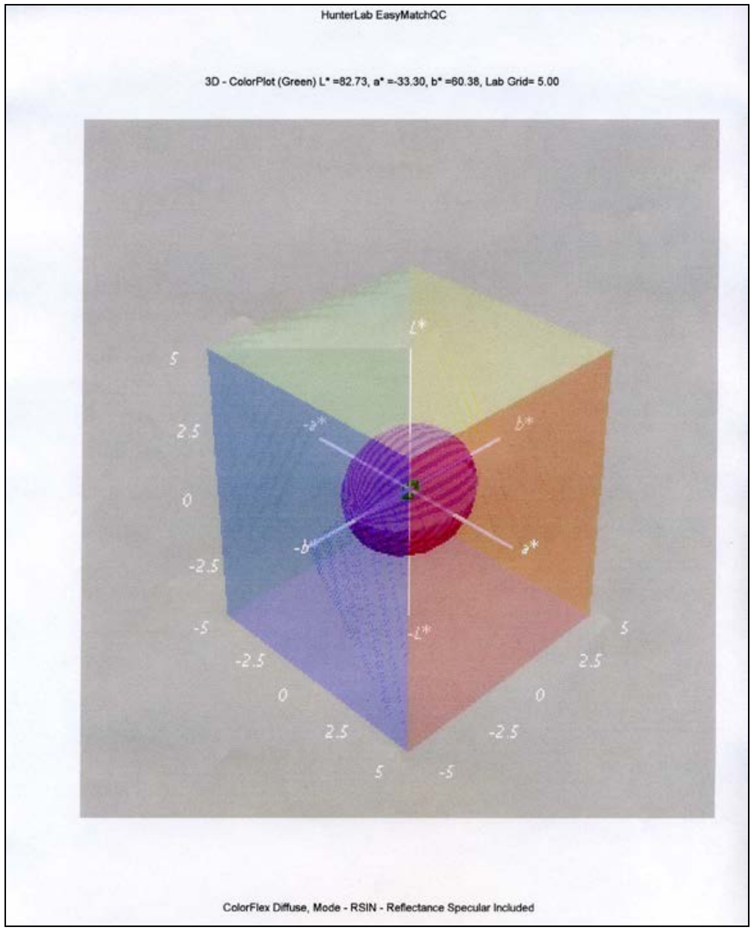


Make your selections for each parameter, including the illuminant, observer, and color scale for display and whether you wish to display a flat representation of two fixed axes. You may also choose whether you wish to view a perspective projection (where data points that are further away from you are smaller than those that are closer) or an orthographic one (where all data points appear at the same scale), opt to turn on rotate mode, in which you may click on the plot and drag it to rotate it, and increase or decrease the opacity of the tolerance indicator.

- **Print Preview:** This command shows on-screen what the 3D Color Plot will look like when printed.



- **Print this View:** This command prints the 3D Color Plot view in a fashion similar to that shown below.



- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 3D Color Plot with a Spectral Plot).

- **Delete View:** This command allows you to remove the current view from the job display.

- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.

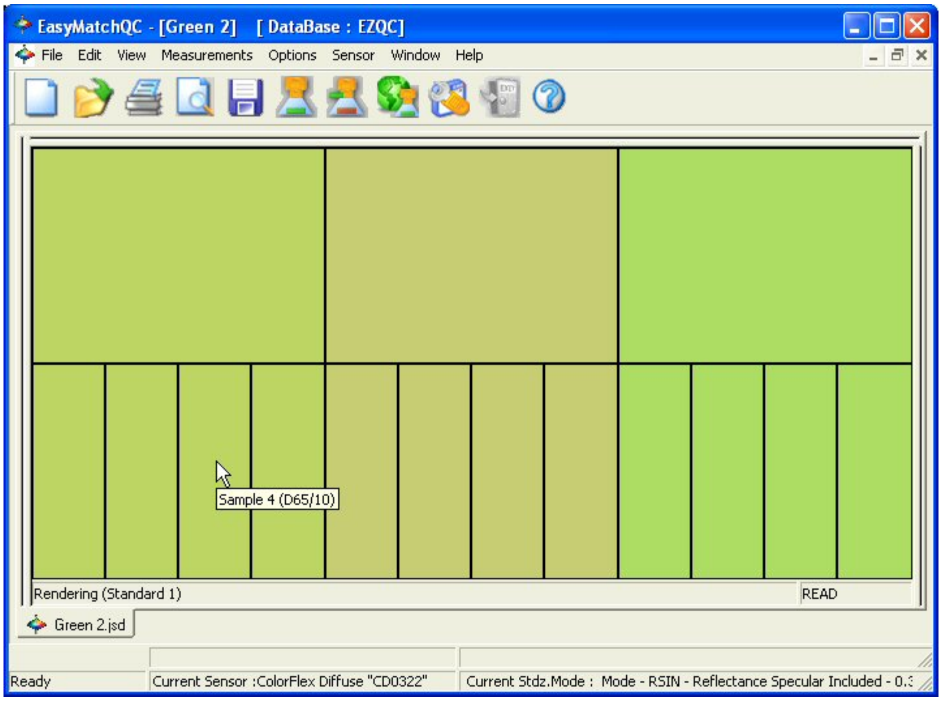
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.

- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.

- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

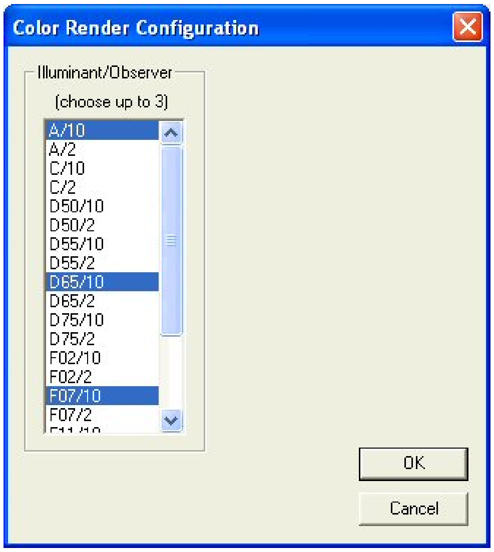
Color Render

The Color Render view shows an accurate color rendering of items highlighted in the Job Tree view. This makes it easy to visually compare standards and samples even when the physical standards and samples are no longer available. By placing the mouse cursor over an area of the Color Render view, you may display a flag indicating the name of the item displayed and the illuminant/observer combination shown.



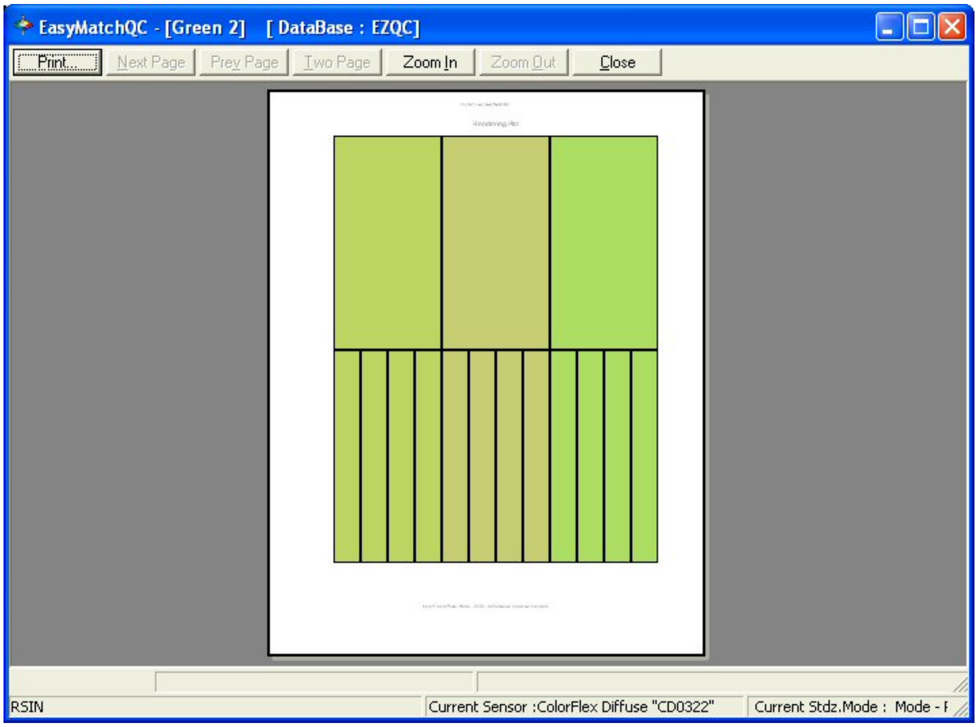
The following options are available by clicking the right mouse button within the boundaries of the view:

- **Configure:** Selection of **Configure** brings up the following dialog box, which allows you to set various preferences pertaining to the Color Render view:

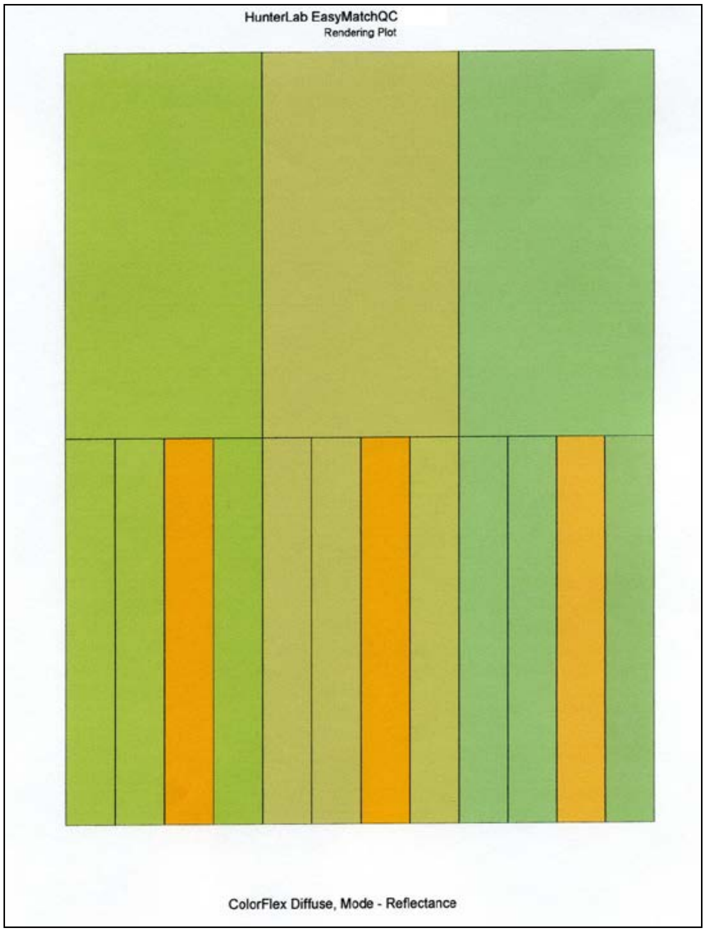


Choose one, two, or three illuminant/observer combinations to render. If more than one combination is chosen, they are displayed side by side on the rendering display.

- **Print Preview:** This command shows you on-screen what the view will look like when printed.



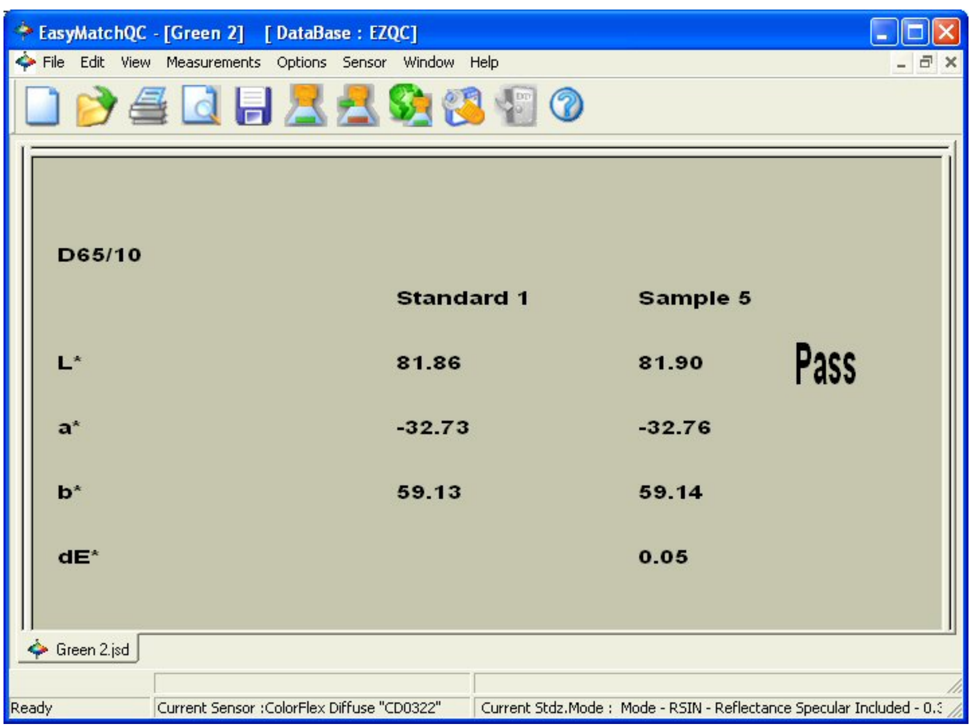
- **Print this View:** This command prints the Color Render view in a fashion similar to that shown below.



- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

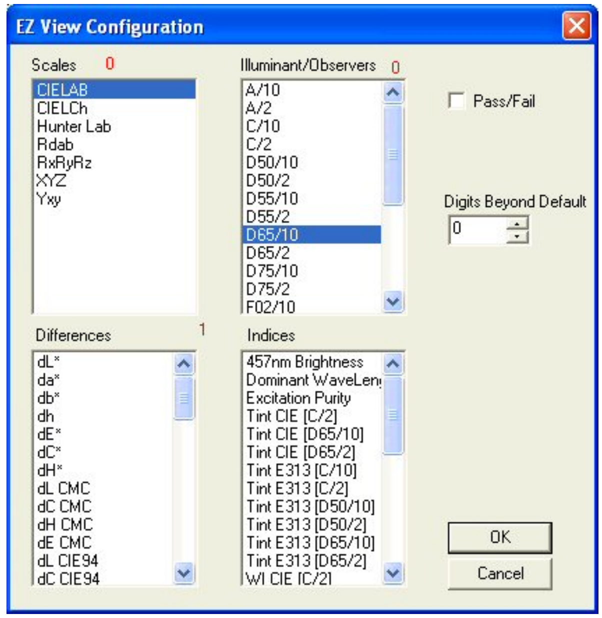
EZ View

The EZ View is a simple, eye-catching display of a limited amount of color data: up to four fields of color scale, difference, and/or index data, as well as pass/fail status if tolerances have been defined for the standard.



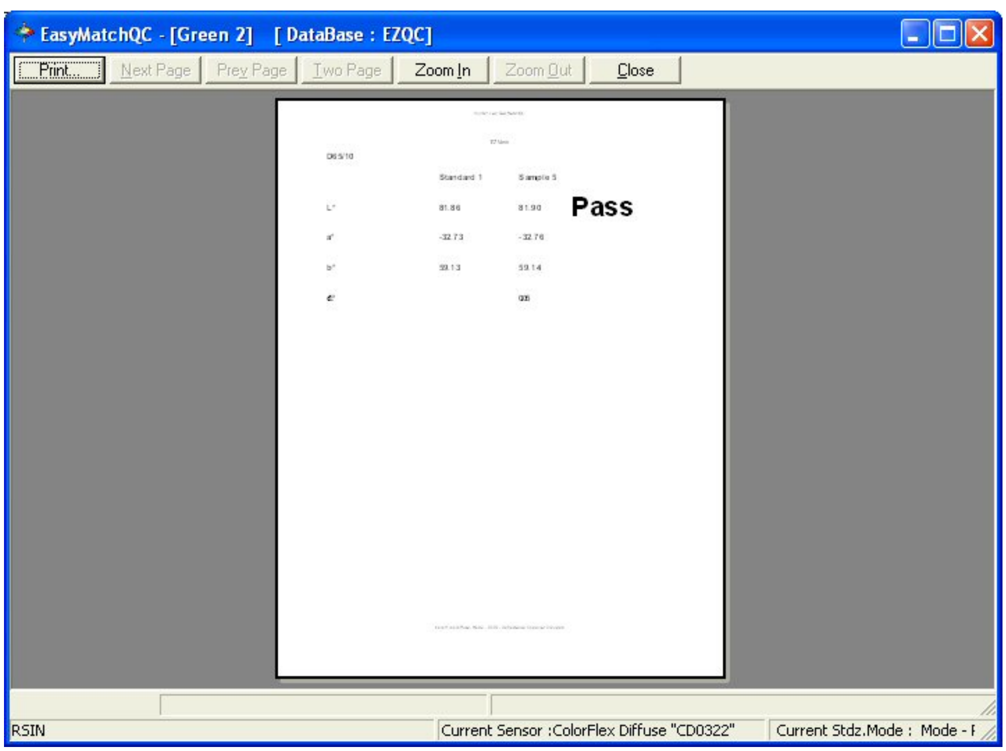
Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Configure:** This command allows you to set various preferences pertaining to the EZ View.

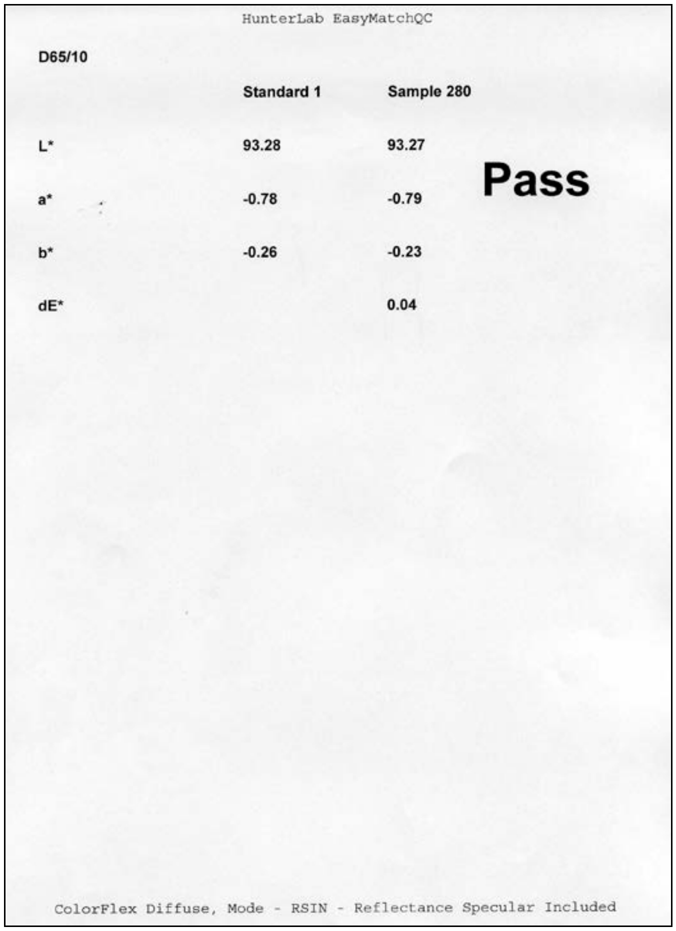


Make one selection in the Illuminant/Observers box and then select either one color scale and one difference or index or a total of four differences and indices. The red number next to each parameter indicates how many more selections you have available.

- **Print Preview:** This command shows you on-screen what the view will look like when printed.



- **Print this View:** This command prints the EZ View in a fashion similar to that shown below.



HunterLab EasyMatchQC

D65/10

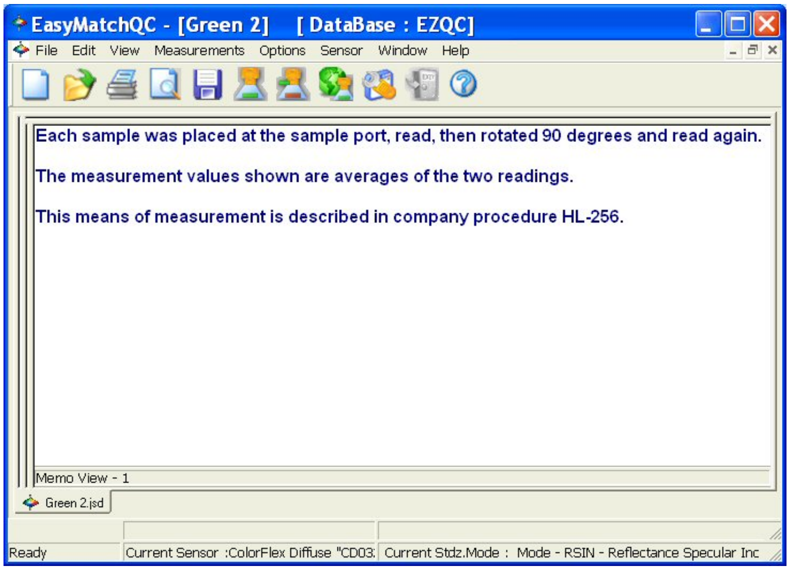
	Standard 1	Sample 280	
L*	93.28	93.27	Pass
a*	-0.78	-0.79	
b*	-0.26	-0.23	
dE*		0.04	

ColorFlex Diffuse, Mode - RSIN - Reflectance Specular Included

- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

Memo View

The Memo View is a blank view in which text, such as comments on the measurement method, may be entered using the keyboard and then stored in the job. An example of this view is shown below.



Click anywhere in the white portion of the view and begin typing to enter your memo. Text does not wrap, so you will want to use the **Enter** key at the end of each line to proceed to the next line. While this view is active, the following options are available by clicking the right mouse button:

- **Cut:** Before using the **Cut** command, use the mouse to highlight the text you wish to remove from the Memo View. Then select **Cut** to permanently remove it from the view. If you wish, you may paste the text elsewhere, such as in a word processing program.

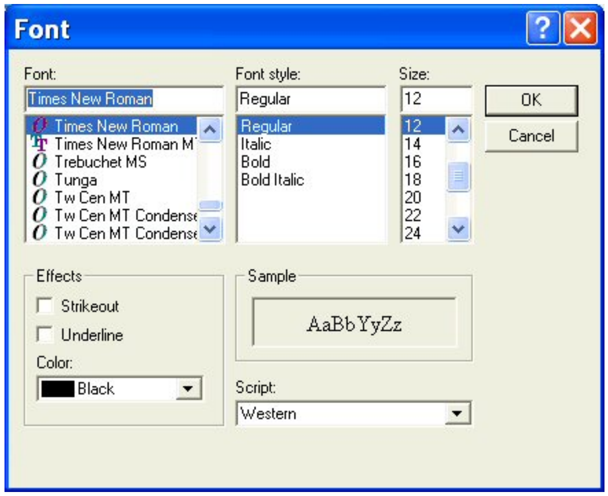
- **Copy:** Before using the **Copy** command, use the mouse to highlight the text you wish to copy to the Windows clipboard. Then select **Copy** to copy it. If you wish, you may paste the text elsewhere, such as in a word processing program.

- **Paste:** Before you may use the **Paste** command, you must have copied text to the Windows clipboard from another job or another program. Then, select **Paste** to paste it into the Memo View.

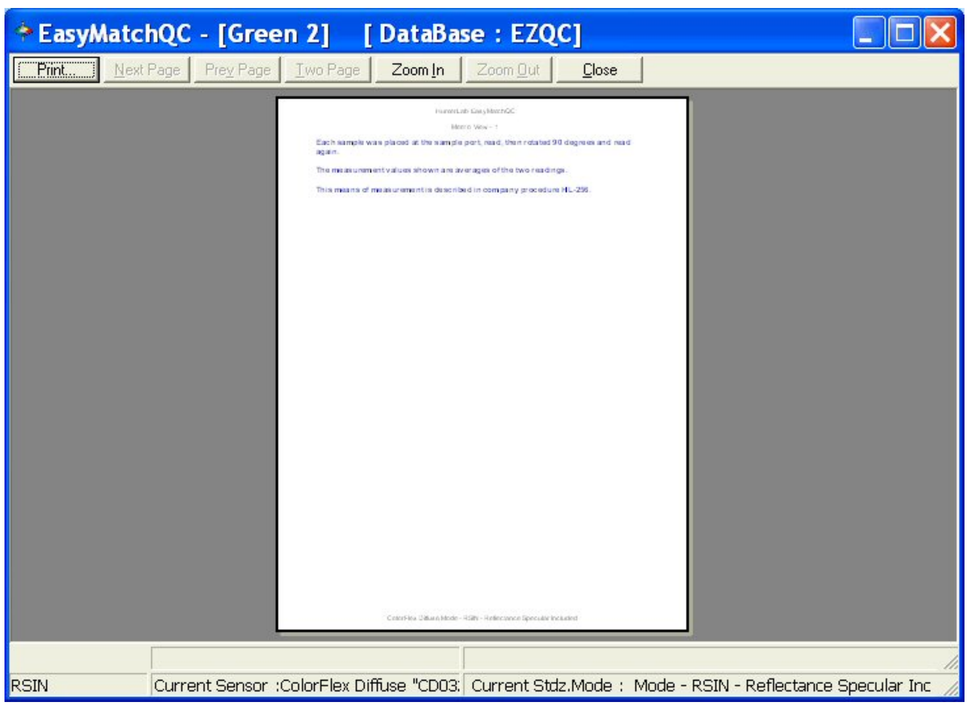
- **Select All:** This command allows you to highlight (select) all the text currently in the Memo View in order to take action on it, such as by setting its font or copying it.

- **Delete:** Before using the **Delete** command, use the mouse to highlight the text you wish to remove from the Memo View. Then select **Delete** to permanently remove it from the view.

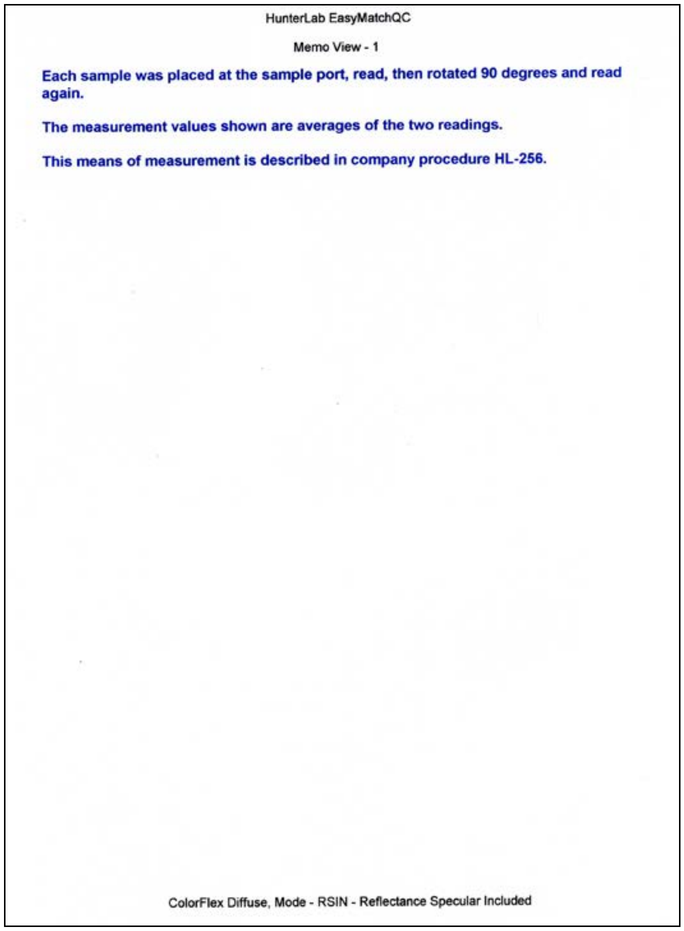
- **Font:** Before using the **Font** command, use the mouse to highlight the text for which you wish to modify the font. Then select **Font** to obtain the following screen on which you may select the text font, size, and color for the highlighted text.



- **Print Preview:** This command shows you on-screen what the view will look like when printed.



- **Print this View:** This command prints the Memo View in a similar fashion to that shown below.



HunterLab EasyMatchQC

Memo View - 1

Each sample was placed at the sample port, read, then rotated 90 degrees and read again.

The measurement values shown are averages of the two readings.

This means of measurement is described in company procedure HL-256.

ColorFlex Diffuse, Mode - RSIN - Reflectance Specular Included

- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).

- **Delete View:** This command allows you to remove the current view from the job display.

- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.

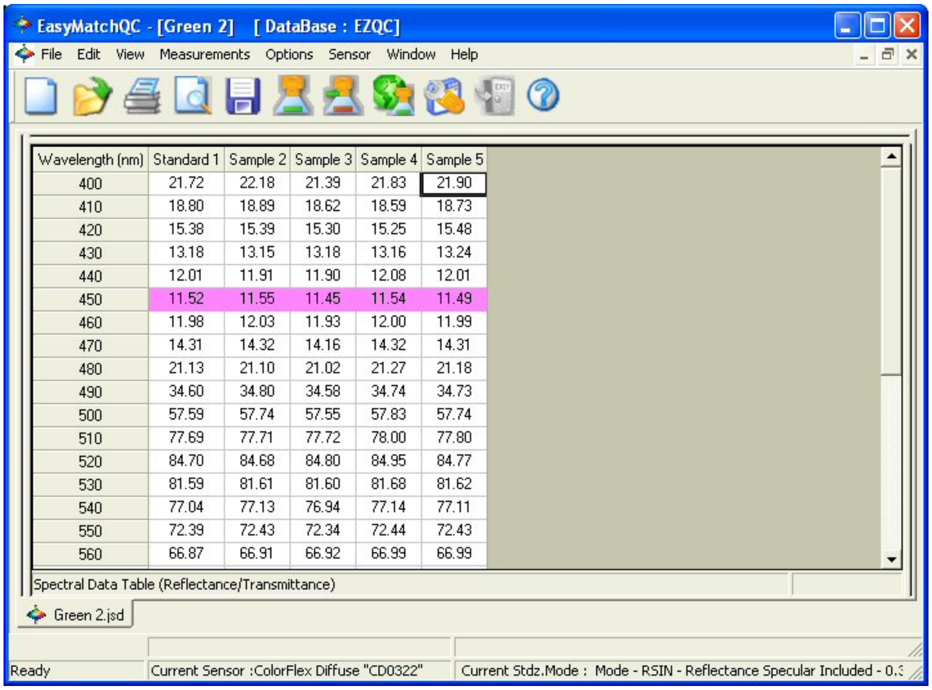
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.

- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.

- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

Spectral Data Table

The Spectral Data Table displays percent reflectance, percent transmittance, K/S, or absorbance values for each selected measurement at the wavelengths being measured. When reflectance, transmittance, or absorbance is being displayed, the cell representing the wavelength of minimum reflectance or transmittance (maximum absorbance) for each measurement is shaded pink. An example of this view is shown below.

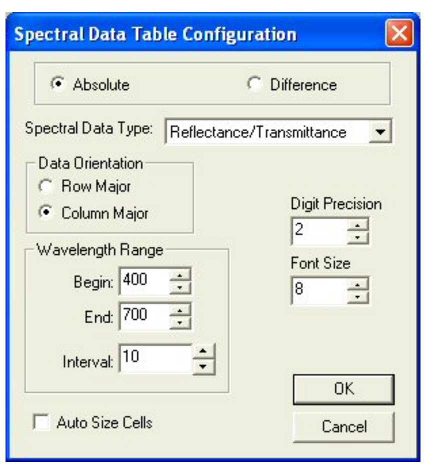


Wavelength (nm)	Standard 1	Sample 2	Sample 3	Sample 4	Sample 5
400	21.72	22.18	21.39	21.83	21.90
410	18.80	18.89	18.62	18.59	18.73
420	15.38	15.39	15.30	15.25	15.48
430	13.18	13.15	13.18	13.16	13.24
440	12.01	11.91	11.90	12.08	12.01
450	11.52	11.55	11.45	11.54	11.49
460	11.98	12.03	11.93	12.00	11.99
470	14.31	14.32	14.16	14.32	14.31
480	21.13	21.10	21.02	21.27	21.18
490	34.60	34.80	34.58	34.74	34.73
500	57.59	57.74	57.55	57.83	57.74
510	77.69	77.71	77.72	78.00	77.80
520	84.70	84.68	84.80	84.95	84.77
530	81.59	81.61	81.60	81.68	81.62
540	77.04	77.13	76.94	77.14	77.11
550	72.39	72.43	72.34	72.44	72.43
560	66.87	66.91	66.92	66.99	66.99

Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Copy to Clipboard:** Before you initiate this command, you must highlight one or more of the samples and standards shown in the spreadsheet. When **Copy to Clipboard** is then selected, the highlighted data is then copied to the Windows Clipboard. If desired, the copied data may then be pasted into another application (such as Microsoft Excel) using its Paste command.

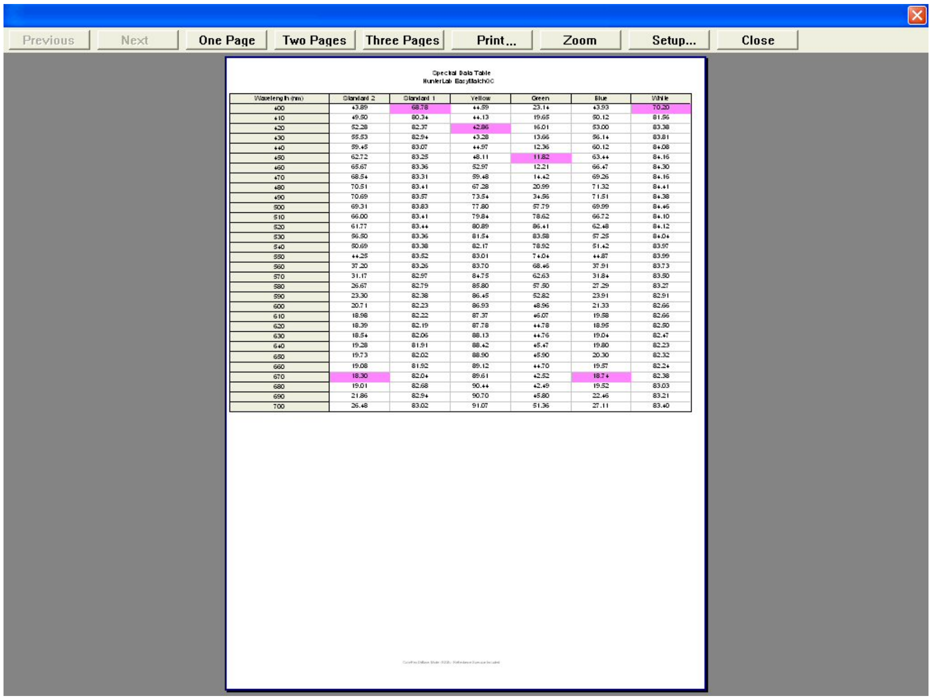
- **Configure:** This command allows you to set various preferences pertaining to the Spectral Data Table view.



Make your selections for each parameter, including the wavelength range and precision and whether you wish to view absolute or difference spectral data. (Difference is available only when the

Spectral Data Type is Reflectance/Transmittance) When Auto Size Cells is checked, the spreadsheet cells will be automatically sized based on the data contained in them.

- **Print Preview:** This command shows you on-screen what the view will look like when printed.



- **Print this View:** This command prints the Spectral Data Table in a similar fashion to that shown below.

Spectral Data Table
HunterLab EasyMatchQC

Wavelength (nm)	Standard 2	Standard 1	Yellow	Green	Blue	White
400	43.89	68.78	44.59	23.14	43.93	70.20
410	49.50	80.34	44.13	19.65	50.12	81.56
420	52.28	82.37	42.86	16.01	53.00	83.38
430	55.53	82.94	43.28	13.66	56.14	83.81
440	59.45	83.07	44.97	12.36	60.12	84.08
450	62.72	83.25	48.11	11.82	63.44	84.16
460	65.67	83.36	52.97	12.21	66.47	84.30
470	68.54	83.31	59.48	14.42	69.26	84.16
480	70.51	83.41	67.28	20.99	71.32	84.41
490	70.69	83.57	73.54	34.56	71.51	84.38
500	69.31	83.83	77.80	57.79	69.99	84.46
510	66.00	83.41	79.84	78.62	66.72	84.10
520	61.77	83.44	80.89	86.41	62.48	84.12
530	56.50	83.36	81.54	83.58	57.25	84.04
540	50.69	83.38	82.17	78.92	51.42	83.97
550	44.25	83.52	83.01	74.04	44.87	83.99
560	37.20	83.26	83.70	68.46	37.91	83.73
570	31.17	82.97	84.75	62.63	31.84	83.50
580	26.67	82.79	85.80	57.50	27.29	83.27
590	23.30	82.38	86.45	52.82	23.91	82.91
600	20.71	82.23	86.93	48.96	21.33	82.66
610	18.98	82.22	87.37	46.07	19.58	82.66
620	18.39	82.19	87.78	44.78	18.95	82.50
630	18.54	82.06	88.13	44.76	19.04	82.47
640	19.28	81.91	88.42	45.47	19.80	82.23
650	19.73	82.02	88.90	45.90	20.30	82.32
660	19.08	81.92	89.12	44.70	19.57	82.24
670	18.30	82.04	89.61	42.52	18.74	82.38
680	19.01	82.68	90.44	42.49	19.52	83.03
690	21.86	82.94	90.70	45.80	22.46	83.21
700	26.48	83.02	91.07	51.36	27.11	83.40

ColorFlex Diffuse, Mode - RSIN - Reflectance Specular Included

- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).

- **Delete View:** This command allows you to remove the current view from the job display.

- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.

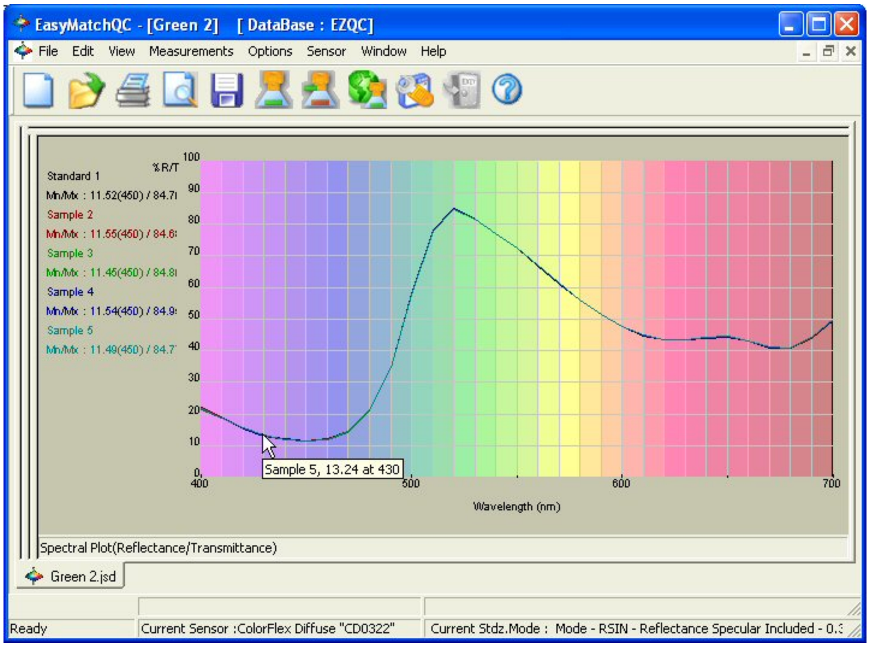
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.

- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.

- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

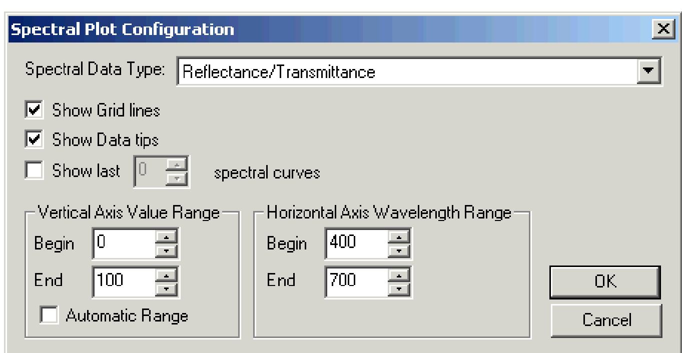
Spectral Plot

The Spectral Plot shows a plot of wavelength versus reflectance, transmittance, K/S, or absorbance for the entire scanning range of the spectrophotometer. The minimum and maximum values and their corresponding wavelengths are shown to the left of the plot.



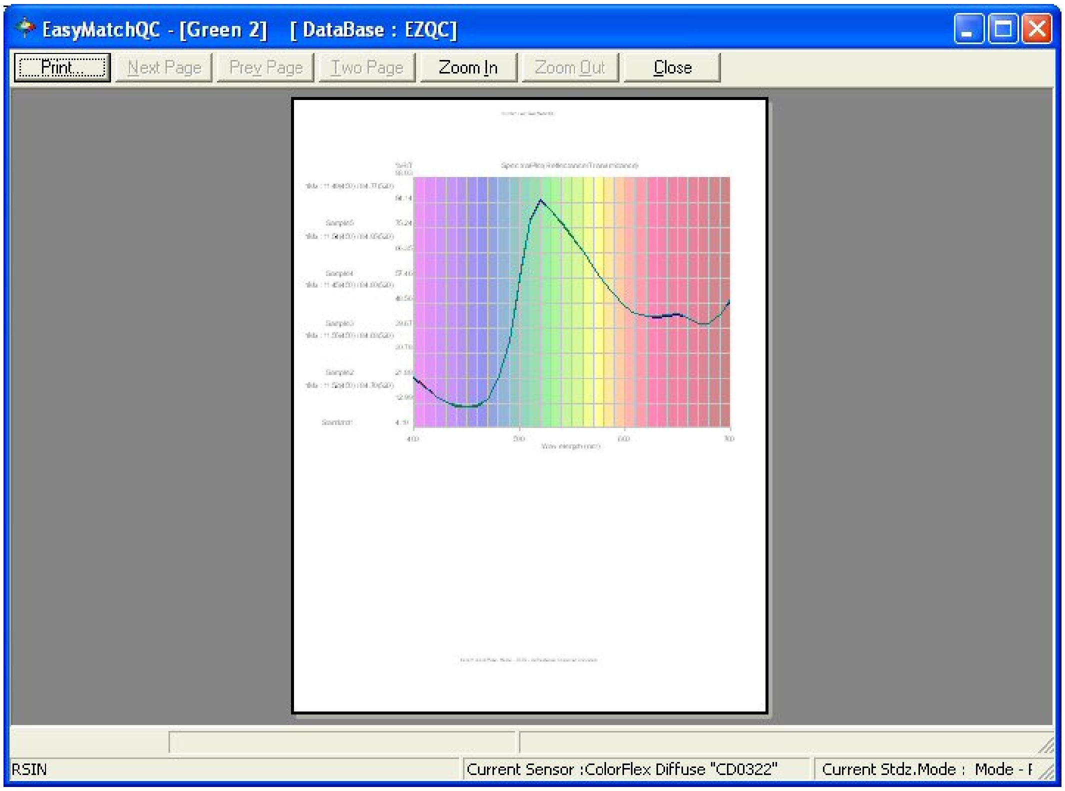
Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

- **Show Background:** This item, when checked, causes the colored background to be shown on the Spectral Plot. When unchecked, the background is white.
- **Show Legend:** This item, when checked, causes the legend (the list of which samples are currently displayed) to be shown to the left of the Spectral Plot. When unchecked, the legend is not shown.
- **Configure:** This command allows you to set various preferences pertaining to the Spectral Plot view.

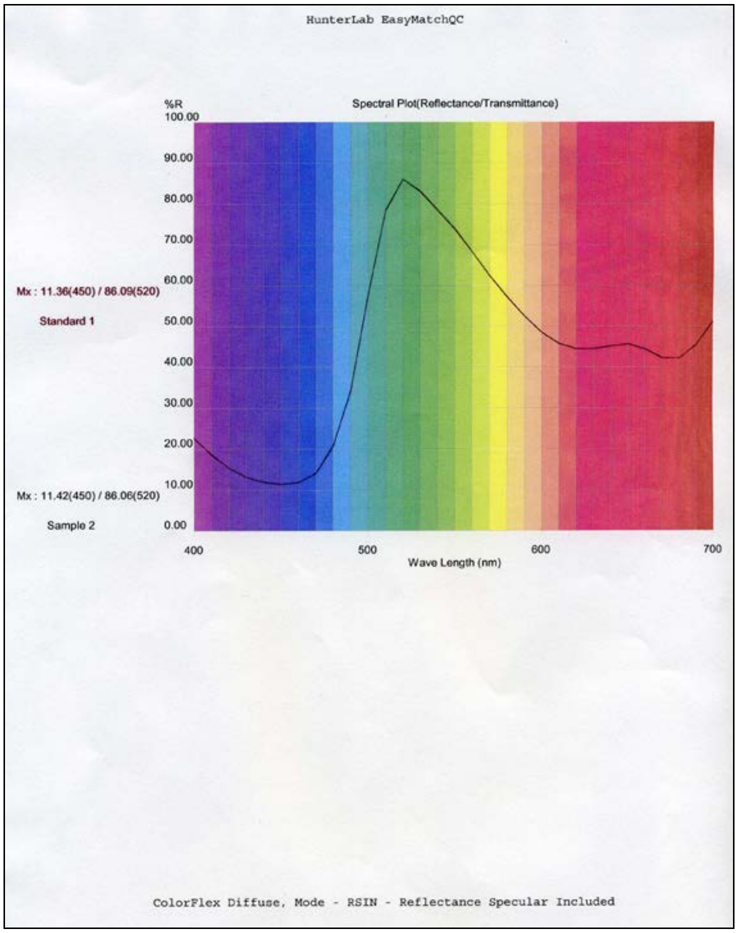


Make your selections for each parameter, including the wavelength and percent ranges.

- **Print Preview:** This command shows you on-screen what the view will look like printed.



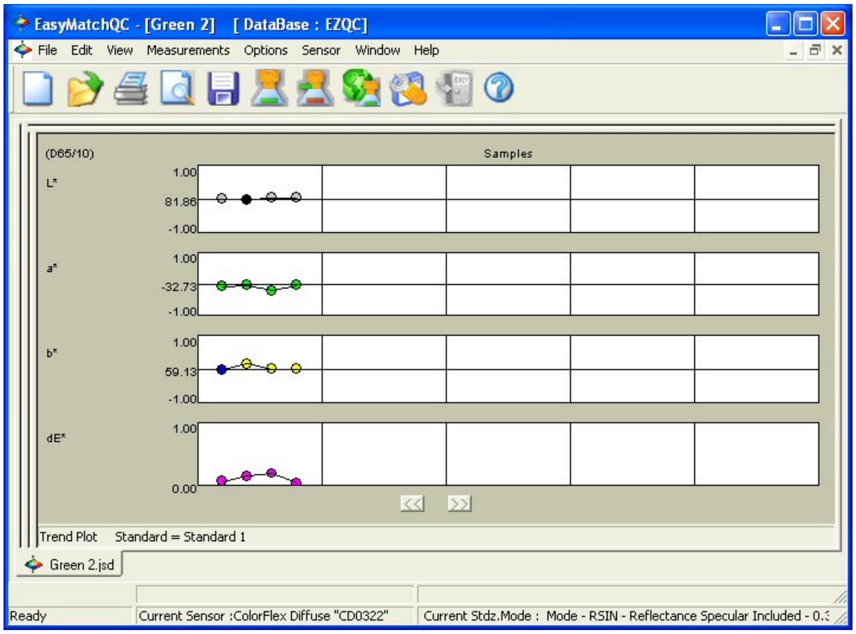
- **Print this View:** This command prints the Spectral Plot view in a similar fashion to that shown below.



- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

Trend Plot

The trend plot displays the trend of the data for each sample relative to the current standard. An example is shown below.

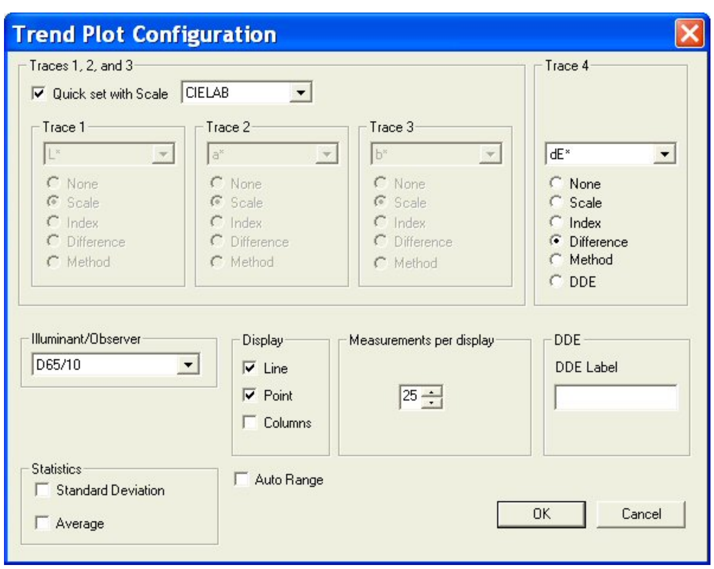


In this example, "Standard 1" is the name of the standard. Four separate graphs are shown, each with three samples displayed. The top graph shows the change in lightness/darkness, or L*. The standard is plotted as the center line of this graph. Samples that are lighter than the standard are shown above this line in white, and samples that are darker are shown below the line in black. The L* value can be estimated based on the scale given to the left of the graph.

Similarly, the second graph shows the change in redness/greenness, or a*. Samples in red above the standard line are redder than the standard and samples in green below the standard line are greener. Yellowness/blueness (b*) is shown on the third graph. dE* is shown at the bottom.

Click on this view to make it active. While this view is active, the following options are available by clicking the right mouse button:

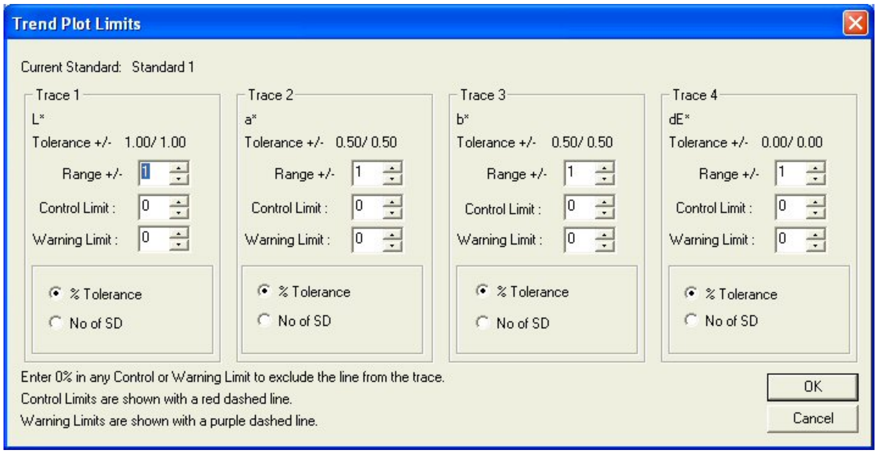
- **Configure:** This command allows you to set various preferences pertaining to the Trend Plot view.



Make your selections for each parameter, including the color scale, fourth trace, and illuminant/observer combination. A line and point display is shown in the example at the beginning of this section. A column display graphs each data point as a rectangle above or below the standard line.

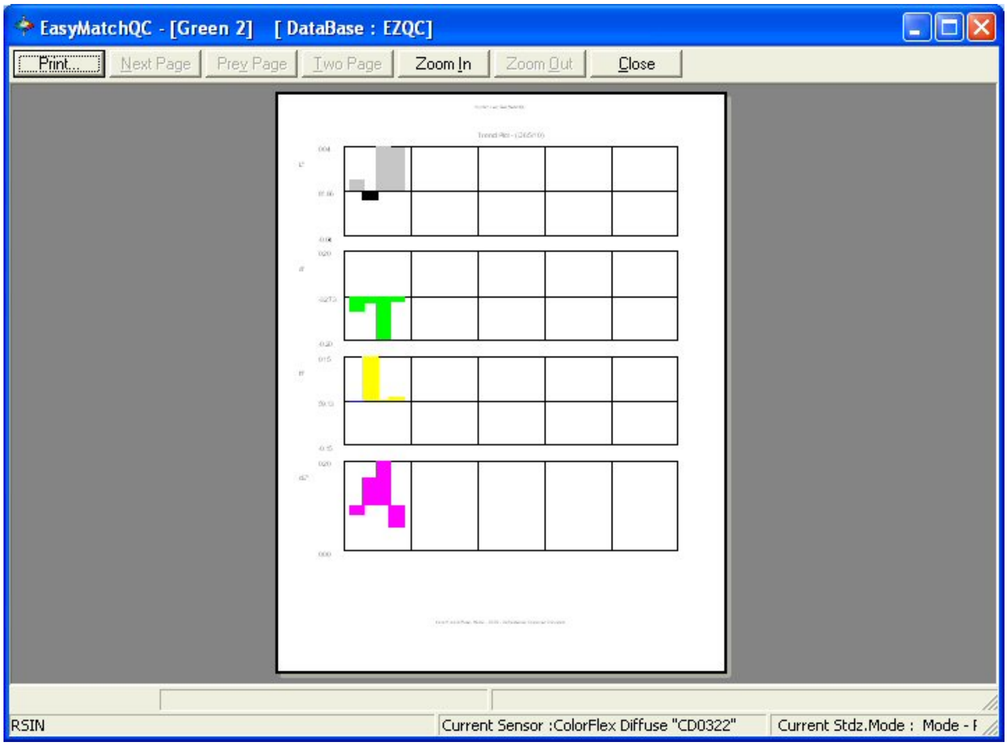
Note: When Statistics are displayed in the Trend Plot, they are calculated based on the values of all the samples shown. The standard values are not included.

- **Limits:** This command allows you to set parameters regarding the scale and limits of the trend plot.

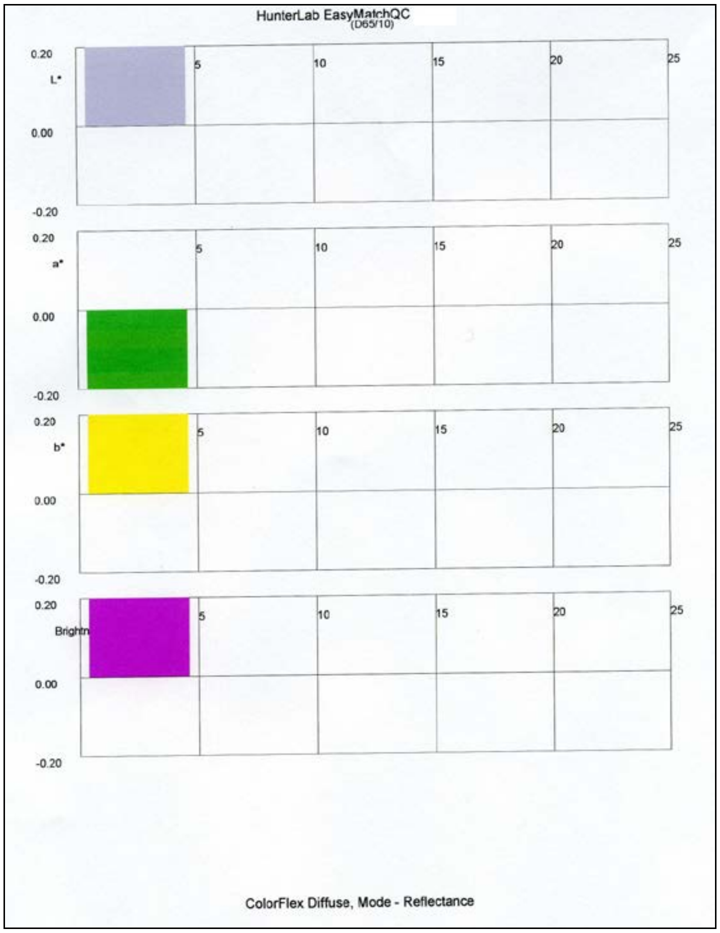


Make your selections for each parameter. The range for each trace is the number of trace units that will be displayed around the standard for the trace. The control limit and warning limit are percentages of the tolerance for the trace or the number of standard deviations from the sample average where indicator lines will be shown (red for the control limit and purple for the warning limit).

- **Print Preview:** This command shows you on-screen what the view will look like when printed.



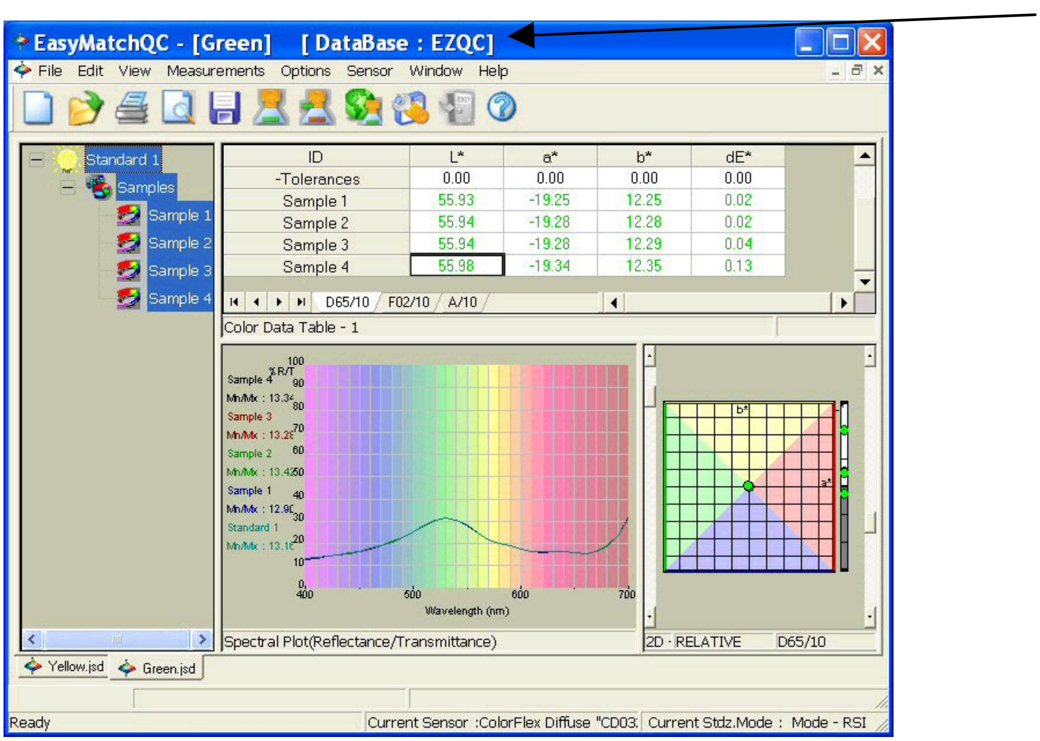
- **Print this View:** This command prints the Trend Plot view in a fashion similar to that shown below.



- **Change View:** This command allows you to replace the current view with another type of view (i.e., replace the 2D Color Plot with a Spectral Plot).
- **Delete View:** This command allows you to remove the current view from the job display.
- **Split View Vertically and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed side by side.
- **Split View Horizontally and Add:** This command splits the current view into two and adds a new view so that the old view and the new view are displayed with one above the other.
- **Maximize this View:** This command causes the currently-selected view to be enlarged to the full size of the job.
- **Restore View:** This command restores the screen to its previous configuration after one view has been maximized.

Database

The database is a permanent repository of all spectral data and ID information for standards and samples that have been specifically saved to the database. When tolerances are assigned to standards, the tolerances can also be saved to the database with the standard. Data that has been saved to the database may be recalled in any job, but data that has been saved into a job has not necessarily been saved to the database. Use of the database is not required. Measurements may be permanently stored only in jobs if desired. The database is in a Microsoft Access (.MDB) or SQL Server format. See the File Menu chapter (Chapter 3) for information on saving data to the database and recalling data from the database and the Options Menu chapter (Chapter 7) for information on configuring the database type and location. Once the database is configured, its name is displayed on the EasyMatch QC title bar after the job name.

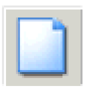


Note: It is recommended that you back up your database, job, and template files periodically, particularly prior to upgrading or other major changes to your system computer.

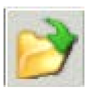
Toolbar Buttons

The toolbar at the top of the screen provides quick access to many functions in EasyMatch QC via its buttons. All functions incorporated into the toolbar may also be accessed through the drop-down menus. The default buttons on the toolbar are shown below in order from left to right on the toolbar, along with a brief explanation of each button's function. The functions of the buttons may be altered, if desired, using the **Customize Toolbar** command in the **Options** menu. See Chapter 7 for instructions.

Default Toolbar Buttons

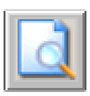


Opens a new job based on the default template.

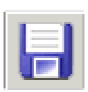


Yields a dialog box that allows you to open an existing job.

Prints the current job to the Windows default printer.



Provides a print preview for the current job.



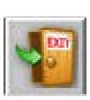
Saves the current job.

Reads a standard from the instrument.

Reads a sample from the instrument.

Initiates instrument standardization.

Opens the sensor diagnostics module for the instrument installed.



Logs the current user out of EasyMatch QC.

Opens the HTML help file.

CHAPTER TWO

Lessons

This chapter provides lessons that walk you step-by-step through some common procedures in EasyMatch QC. These lessons have you configure screens and use sample data which may not apply to your situation. However, if you work through the lessons you should end up with a good feel for how the software operates and then you can substitute your own samples and displays for the examples.

Lesson 1 describes setting up a job template, including choosing and configuring data views.

Lesson 2 describes a typical standardization sequence and how to check that standardization was successfully completed.

Lesson 3 describes measuring in a transmission mode.

Lesson 4 describes setting up and using a hitch standard.

Lesson 5 describes querying the database in order to recall or delete data.

Lesson 6 describes how to use the autolerancing feature.

Lesson 7 describes how to transfer datalog readings from a MiniScan EZ, MiniScan XE Plus, or ColorFlex into EasyMatch QC and how to send product setups back and forth between the instrument and the computer.

Lesson 8 shows how to configure and use custom data and formula fields.

Lesson 9 shows you how to set up a printed job report.

Lesson 10 shows you how to obtain shade numbers for your measurements.

Lesson 11 demonstrates how to use a data series instead of a standard.

Lesson 12 demonstrates how to make and average several readings.

Lesson 1: Setting Up a Job Template

Suppose you wish to configure a job template called "Lesson 1" to use for jobs in which you display your measurement data. The information you require is listed below.

- The Job Tree

- A Color Data Table displaying (in this order) CIELAB, dE*, and Y brightness using D65/10 and C/2, the date and operator for the measurements, and the average of the displayed measurements

- A relative 2D Color Plot using D65/10

- A Trend Plot for dL*, da*, db*, and dE* using D65/10.

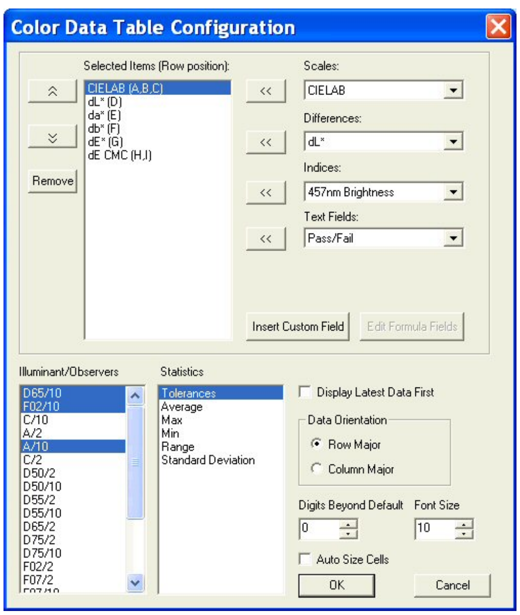
You also wish to enter default CIELAB tolerances for standards read into jobs based on this template.

1. Choose **New Job** from the **File** menu. A new job based on the current default template is opened.

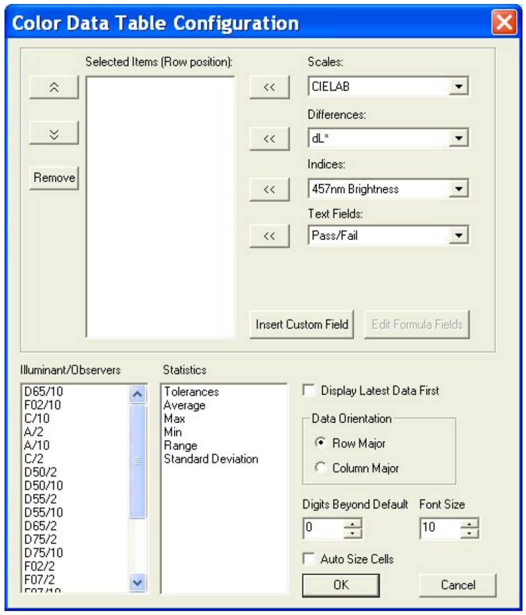
2. Open the **View** menu and confirm that **Job Tree** is checked. If it is not, select it.

3. Right-click on the view just to the right of the Job Tree and at the top of the screen. Select **Change View** from the menu that appears and then **Color Data Table**. The view will be changed to the Color Data Table.

4. Right-click the Color Data Table display and choose **Configure** from the menu that appears. The Color Data Table Configuration screen is shown.



5. Highlight each item in the Selected Items box in turn and click **Remove** to remove it from the box. Scroll through the Illuminant/Observers and Statistics boxes. Click on any selected (highlighted) items to deselect them.



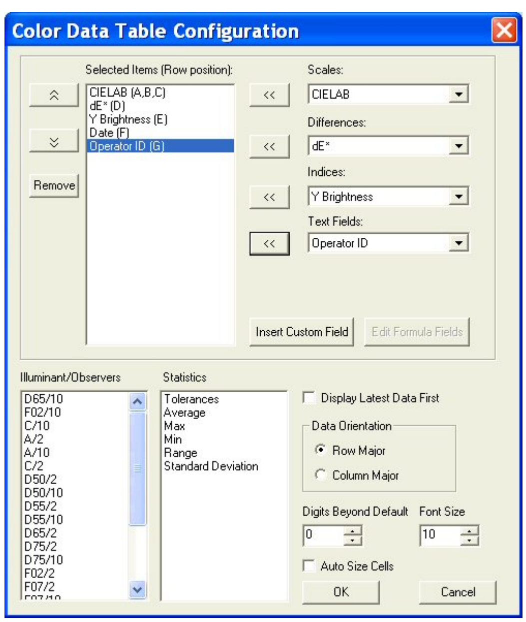
6. Locate CIELAB in the Scales drop-down list and select it. Click the left arrow (<<) button next to the Scales list. CIELAB will move into the Selected Items box.

7. Locate dE* in the Differences drop-down list and select it. Click the left arrow (<<) button next to the Differences list. dE* will move into the Selected Items box.

8. Locate Y Brightness in the Indices drop-down list and select it. Click the left arrow (<<) button next to the Indices list. Y Brightness will move into the Selected Items box.

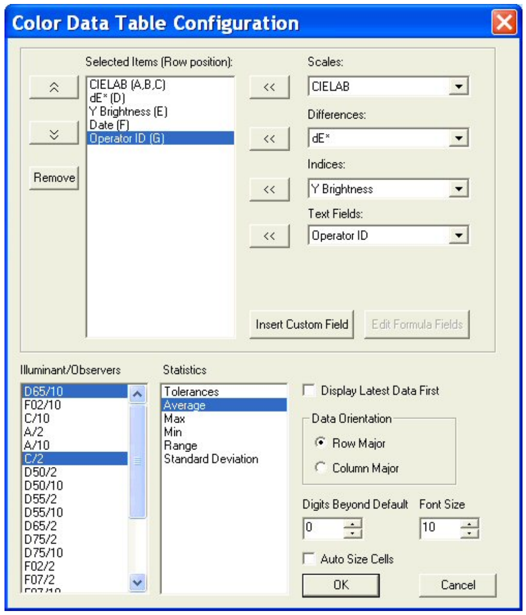
9. Locate Date in the Text Fields drop-down list and select it. Click the left arrow (<<) button next to the Text Fields list. Date will move into the Selected Items box.

10. Locate Operator ID in the Text Fields drop-down list and select it. Click the left arrow (<<) button next to the Text Fields list. Operator ID will move into the Selected Items box.



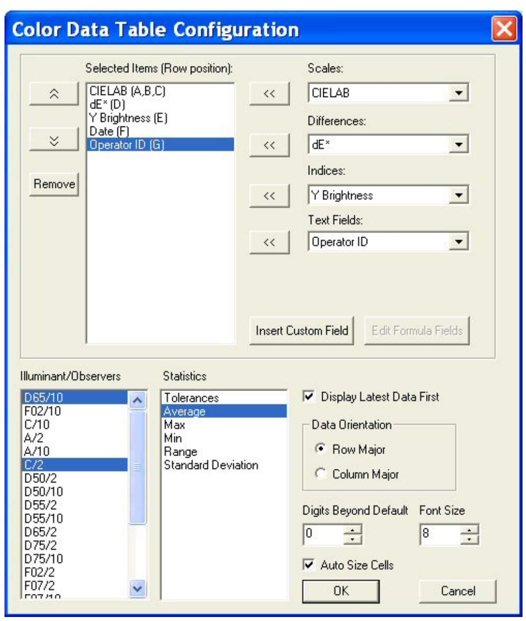
11. Click D65/10, then C/2 in the Illuminant/Observers box to select them.

12. Click Average in the Statistics box to select it.



13. At the right bottom of the screen, make the following selections:

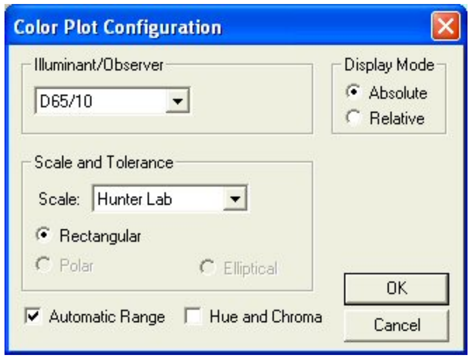
Display Latest Data First	Checked
Data Orientation	Row Major
Digits Beyond Default	0
Font Size	8
Auto Size Cells	Checked



14. Click **OK** to accept the configuration.

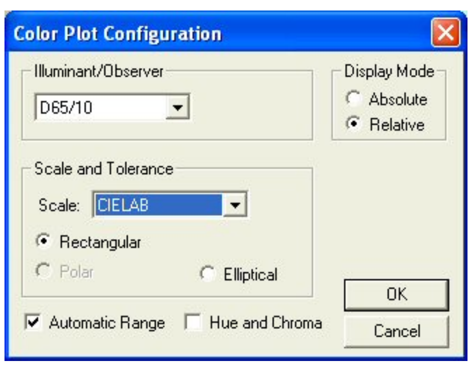
15. Right click the data view to the right of the Color Data Table at the top of the screen. Select **Change View** from the menu that appears and then **2D Color Plot**. The view will be changed to the 2D Color Plot. If there is not currently a data view to the right of the Color Data Table, right click on the Color Data Table and choose **Split View Vertically and Add** and choose **2D Color Plot**. The 2D Color Plot will be added to the right of the Color Data Table.

16. Right click the 2D Color Plot view and choose **Configure** from the menu that appears. The Color Plot Configuration screen is shown.



17. Make the following selections on the Color Plot Configuration screen:

Illuminant/Observer	D65/10
Display Mode	Relative
Scales and Tolerances	CIELAB, Rectangular
Automatic Range	Checked
Hue and Chroma	Unchecked

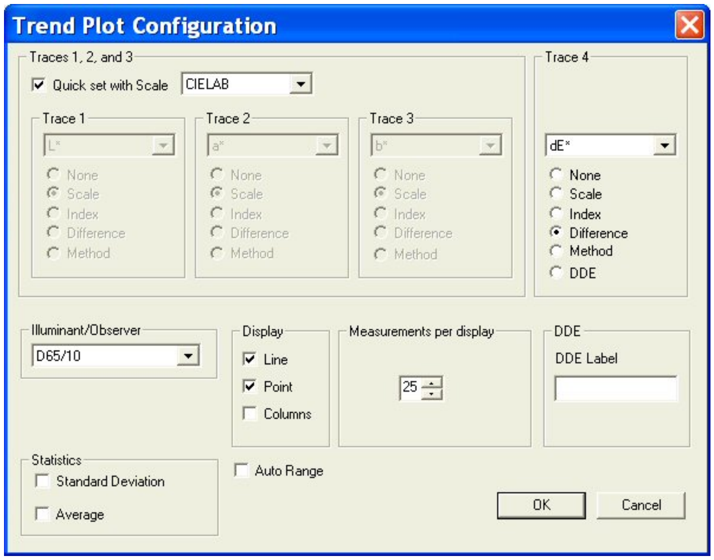


18. Click **OK** to accept the configuration.

19. Right-click the 2D Color Plot and select (check) both **Show Background** and **Show Legend**.

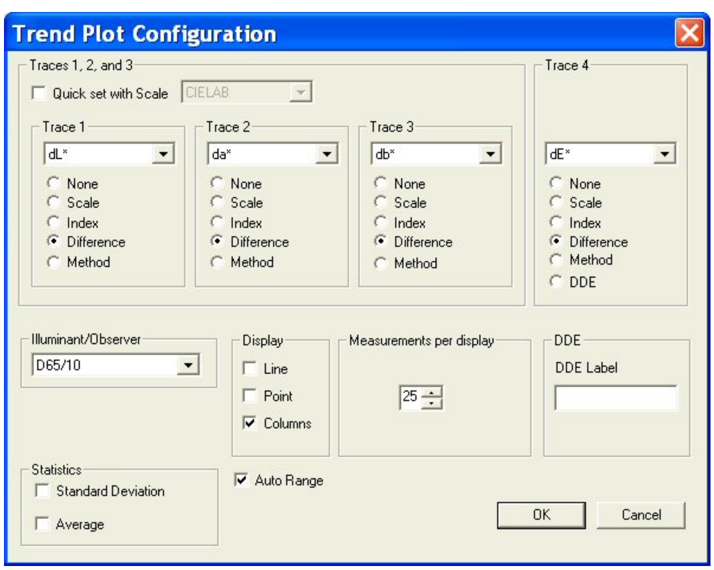
20. Right click the data view across the bottom of the screen. Select **Change View** and then **Trend Plot** from the menu that appears. The view will be changed to the Trend Plot.

21. Right click the Trend Plot and select **Configure**. The Trend Plot Configuration screen appears.



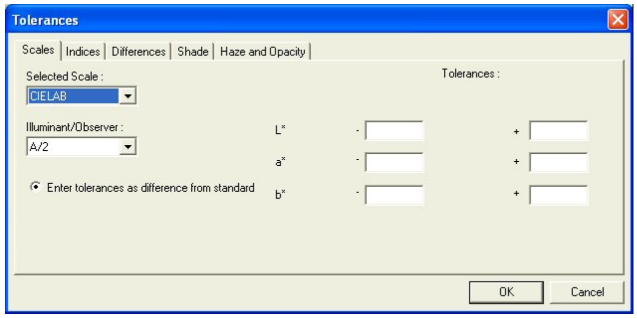
22. Make the following selections on the Trend Plot Configuration screen:

Quick set with Scale	Unchecked
Trace 1	Difference, dL*
Trace 2	Difference, da*
Trace 3	Difference, db*
Trace 4	Difference, dE*
Illuminant/Observer	D65/10
Display	Columns
Measurements per display	25
Statistics	Both items unchecked
Auto Range	Checked.

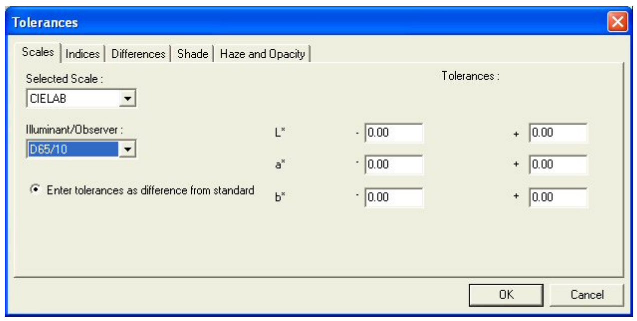


23. Click **OK** to accept the configuration.

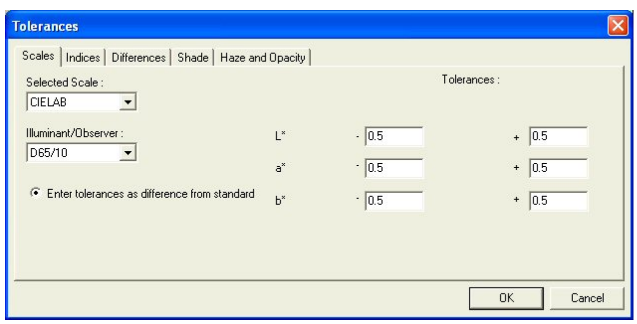
24. Choose **Default Tolerances** from the **Options** menu. The Tolerances screen appears.



25. On the **Scales** tab, choose CIELAB from the drop-down box beneath Selected Scale. Also choose D65/10 from the drop-down box beneath Illuminant/Observer.

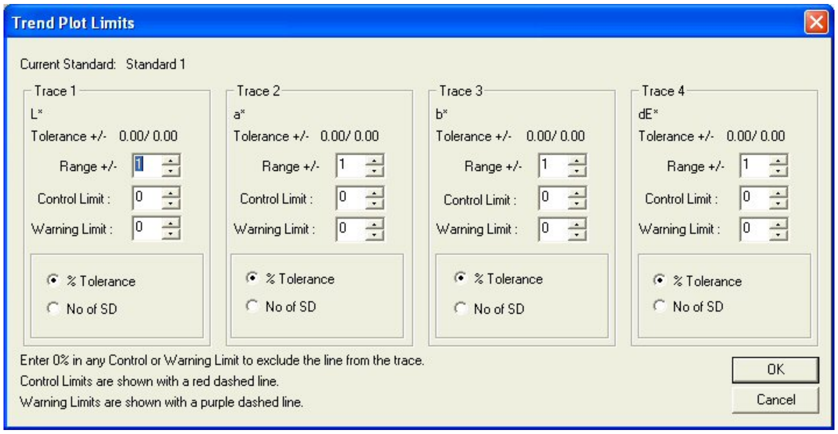


26. On the right side of the screen, enter 0.5 into all six boxes for upper and lower tolerances of one-half unit.



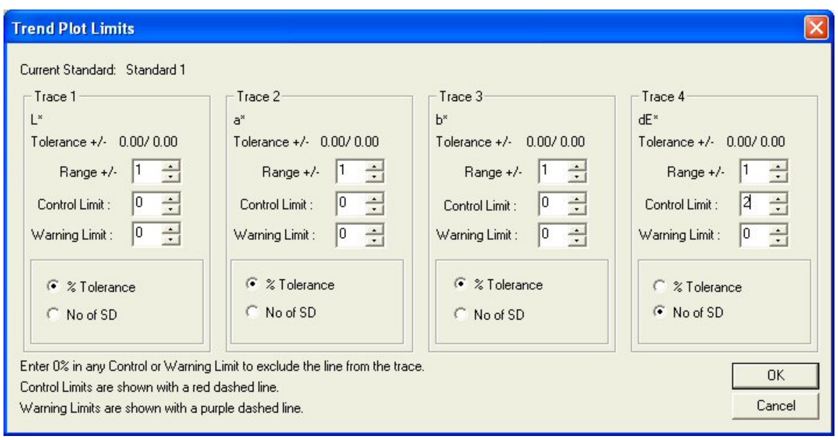
27. Click **OK** to accept the tolerances.

28. Right click the Trend Plot view and select **Limits**. The Trend Plot Limits screen appears.



29. On the Trend Plot Limits screen, make the following selections:

Trace 1 Range	Do not change, since we selected Auto Range in Step 16
Trace 2 Range	Do not change, since we selected Auto Range in Step 16
Trace 3 Range	Do not change, since we selected Auto Range in Step 16
Trace 4 Range	Do not change, since we selected Auto Range in Step 16
Trace 4 Control Limit	2 standard deviations



30. Click **OK** to accept the limits.

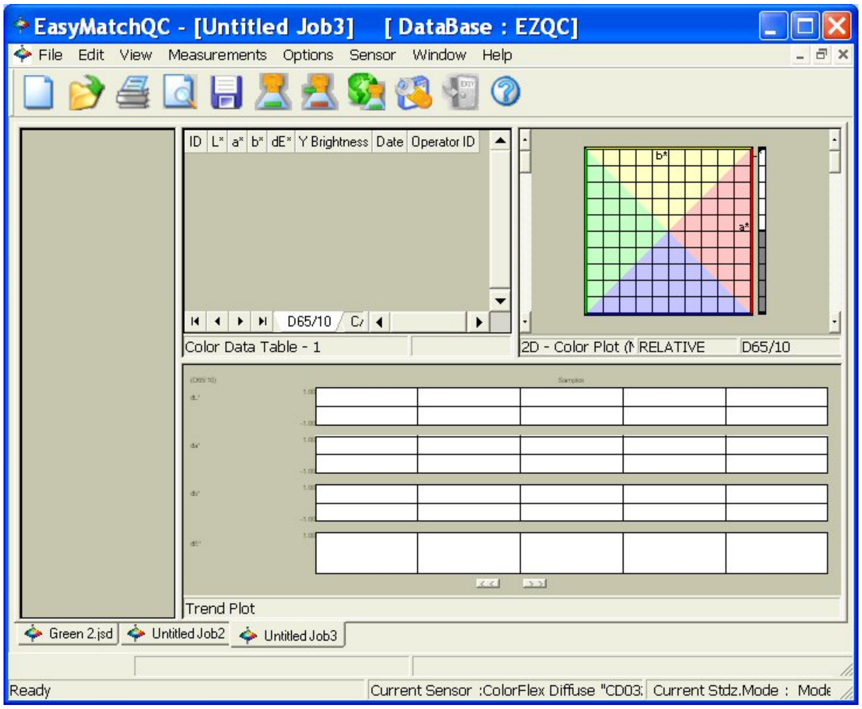
31. If any extra displays are shown on your screen, right click on each one and choose **Delete View** from the menu that appears.

32. Back on the template screen, select **Save Job Template** from the **File** menu. Choose to name the template "Lesson 1" and save it in the Job Templates subfolder to EasyMatch QC.

33. Move your mouse over the right edge of the Job Tree until a double-headed arrow appears.

34. Click and drag the mouse to the left to decrease the size of the Job Tree slightly, then release the mouse button.

35. Move the side, top, and bottom edges of the other displays until each is the desired size for maximum visibility.



36. Select **Save Job Template** from the **File** menu. The template will be saved again.

37. Close the open job.

38. Choose **Application Preferences** from the **Options** menu. The Application Preferences screen appears.

39. On the Startup Defaults tab, Select Lesson 1 for the Default Template and click **OK**.

40. The Lesson 1 template will now be used automatically each time you open a new job.

Lesson 2: Standardizing and Confirming Standardization Using the White Tile

This lesson will walk you through an example reflectance standardization for a LabScan XE. Other instruments are standardized in slightly different fashions. After standardization, we will confirm a reading of the white calibration tile. Your instrument should already be attached to the computer and installed in EasyMatch QC before performing this lesson.

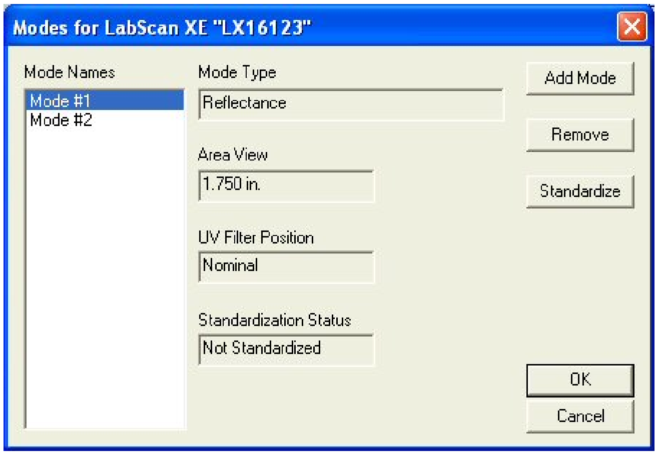
Instructions for standardization in transmittance are provided in Lesson 3.

This lesson does not apply to the ColorQuest XT.

1. Open a new job.

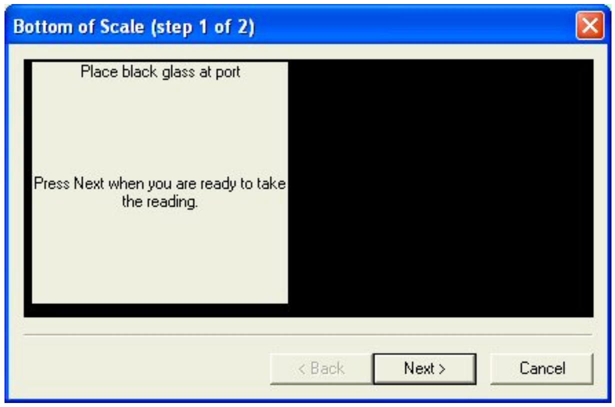
2. Choose **Set Modes** from the **Sensor** menu. The following screen will appear.

   *Note: If your instrument is a ColorFlex or MiniScan, only one mode is available and you should simply click the **Standardize** button on the toolbar and skip to Step 3.*



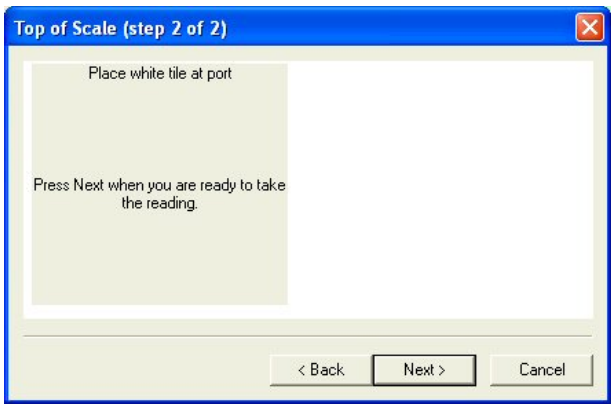
3. Highlight each of the existing modes in turn and examine the parameters shown on the right side of the screen until you find the standardization mode desired (reflectance or RSIN). If such a mode doesn't exist, create it using the **Add Mode** button.

4. With the desired mode selected (highlighted), click **Standardize**. The following prompt will appear. If you are using a diffuse (sphere) instrument, you will be prompted for the light trap rather than the black glass.



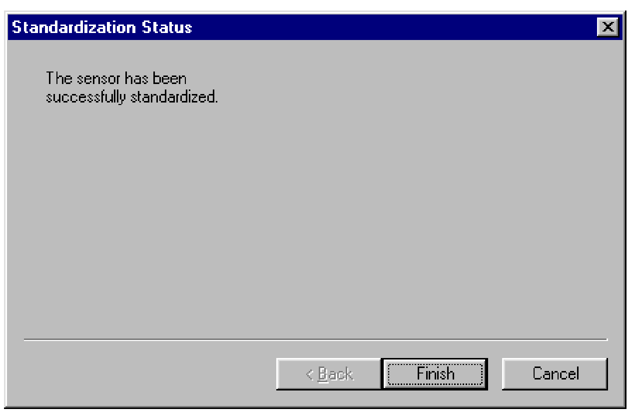
5. Center the black glass at the measurement port with the shiny side toward the port. For a sphere instrument, cover the reflectance port with the light trap. Click **Next** to continue.

6. The instrument will read the glass or trap and set the zero. When it is finished, the following prompt will appear.



7. Center the white tile at the measurement or reflectance port with the white side toward the port. Click **Next**.

8. The instrument will read the white tile and set the top of scale. Then the following notice will appear.



9. Click **Finish** to complete the standardization process and **OK** to exit the Modes screen. You will see the standardization mode update on the right side of the status bar if you chose to view the status bar. Do not move or remove the white tile.

10. Next we will check that standardization was successfully completed by taking a reading of the white tile. First configure a Color Data Table view to show the XYZ color scale using D65/10. See Lesson 1 if you need help.

11. Click the **Read Sample** button on the toolbar.

12. Enter "White Tile" if prompted for the Sample ID and click **OK**.

13. The white tile will be read and the measurement values placed in the Color Data Table.

14. Remove the white tile from the instrument port and compare the values read to the values printed on the label on the back of the tile. The values just read should differ by no more than **0.1** units in X, Y, and Z from the printed values (**0.4** for ColorFlex, MiniScan XE Plus, and MiniScan EZ). If any of them differs too much, try standardizing and reading the tile again. If the reading is still "off," clean the black glass and white tile as described in Chapter 11 and try the entire procedure again. If the white tile reading is still off, perform the green tile check procedure described in the Sensor Menu chapter.

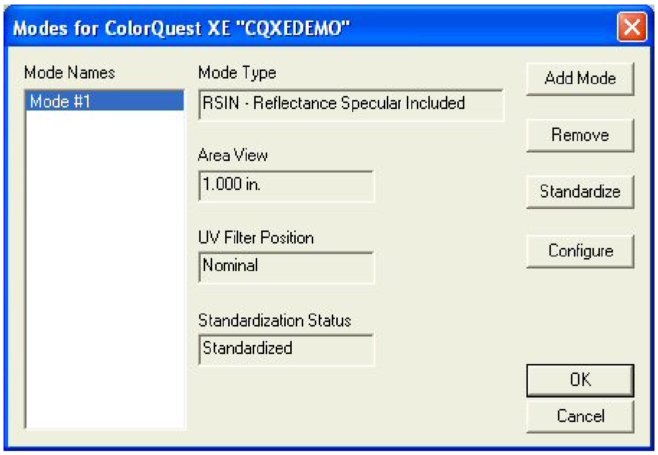
    Note: This is NOT the repeatability test that is performed at the factory on new instruments.

Lesson 3: Measuring in a Transmittance Mode

This lesson is appropriate only if you are using an instrument capable of measuring in transmission. If you are using a ColorQuest XE, ColorQuest XT, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, or UltraScan VIS, proceed with this lesson. If you are using a ColorFlex, ColorQuest 45/0 LAV, LabScan XE, MiniScan XE Plus, or MiniScan EZ, do not attempt this lesson. Your instrument should already be attached to the computer and installed in EasyMatch QC before performing this lesson.

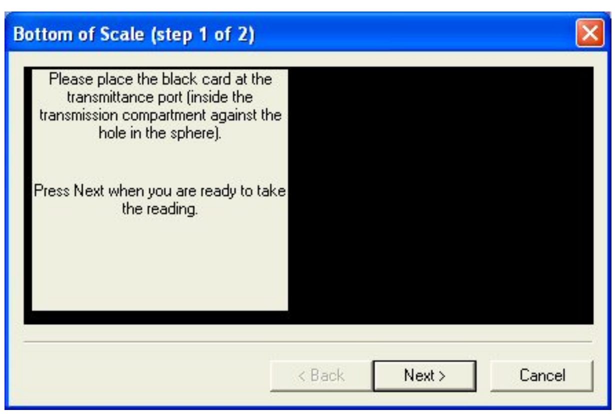
Most transmission measurements are made using the TTRAN (total transmittance) mode. The steps required for performing this type of measurement are described below.

1. Choose **Set Modes** from the **Sensor** menu. The following screen will appear.

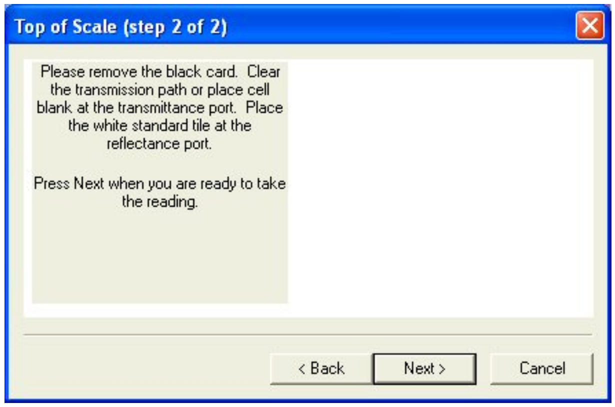


2. Highlight each of the existing modes in turn and examine the parameters shown on the right side of the screen until you find the standardization mode desired (TTRAN for the largest area view available with the UV Filter Position Nominal). If such a mode doesn't exist, create it using the **Add Mode** button.

3. With the desired mode selected (highlighted), click **Standardize**. The following prompt will appear.

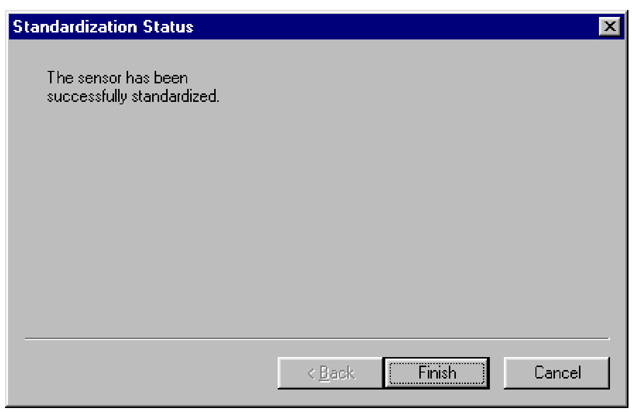


4. Place the black card inside the transmission compartment, flat against the hole in the sphere. Close the transmission compartment door as much as possible and click **Next**.



5. Remove the black card from the transmission compartment. If you will be measuring a film or other clear solid sample, simply click **Next** to continue the standardization process. If you will be measuring a liquid, place a clear liquid (distilled water for water-based samples, toluene or benzene for resins, or mineral oil for oils) in a cell of the desired size and center the clear portion of the cell over the transmission port (sphere) in the transmission compartment. It is suggested that you use a transmission cell holder to do so. Close the transmission compartment door.

6. Place the white standard tile at the reflectance port (outside the instrument) with the white side toward the port. (This instruction does not apply to ColorQuest XT.) Then click **Next** to set the top of scale. Standardization is then complete. Click **Finish** and then **OK** to exit the Modes screen. Leave the white tile at the reflectance port while you make your measurements.



7. Center your sample over the transmission port (the hole in the sphere inside the transmission compartment). If you are measuring a film or flat solid sample, using the transmission clamp to hold the sample flat against the port is recommended. If you are measuring a liquid sample, fill an appropriately-sized transmission cell with the liquid and center one of the clear sides of the cell over the transmission port. Use of a transmission cell holder is recommended. Be sure that the level of the liquid is sufficient to cover the opening in the sphere and that the cell is flat against the opening. Close the transmission compartment door.

Note: The size of the transmission cell used for sample measurements must match that of the cell used for standardization.

8. Read the sample as a standard or sample by pressing **F2** or **F3**, respectively. Other samples may then be placed in the transmission compartment and read, if desired.

Lesson 4: Using a Hitch Standard

Hitch standardization can be used to make your instrument read samples of a particular color the same way as another instrument, improving agreement. If a product standard has been measured on another instrument and color or spectral values have been assigned to it, then your instrument can be adjusted to those values so that samples you read are corrected for any differences between the two instruments.

To perform a hitch standardization you need a standard with either color values or spectral values assigned to it. Your instrument should already be attached to the computer and installed in EasyMatch QC before performing this lesson.

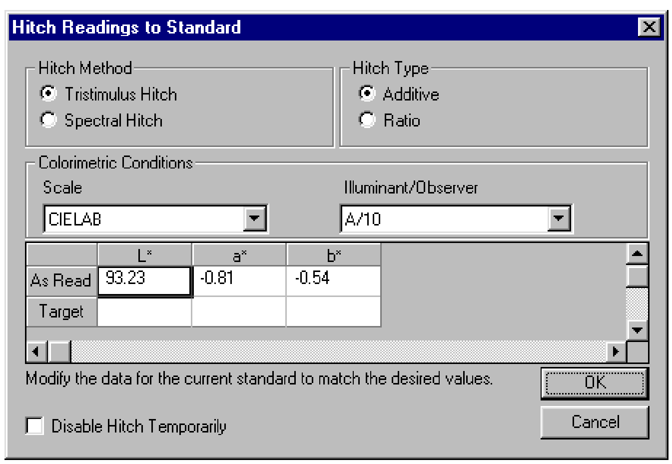
1. Standardize the instrument in the same mode in which the hitch standard's color values were obtained. In this example we'll use RSIN (reflectance) mode.

2. Place the standard at the measurement port and measure it by choosing **Read Standard** from the **Measurements** menu. For this example, read your instrument white tile.

3. Select (check) **Job Tree** in the **View** menu if it is not already displayed.

4. Right click on the standard you just read in the Job Tree and select **Properties** from the menu that appears.

5. Click on the **Hitch** button. The Hitch Readings to Standard screen appears.



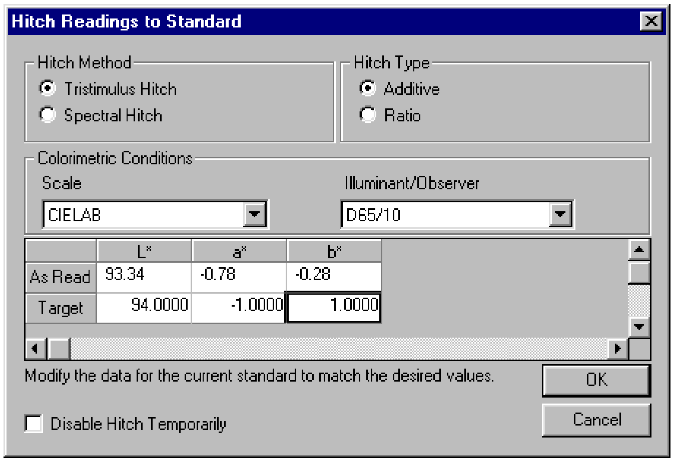
6. Select whether the assigned values are spectral or tristimulus (color values). We happen to have tristimulus values.

7. Choose whether you wish to use a ratio or additive hitch. For this lesson, choose Additive.

   An **additive hitch** is a simple linear offset from the values measured using your instrument. The value displayed in the Color Data Table for each parameter (such as L, a, and b) is the measured value plus the offset value indicated by the hitch standard. The offset value may be positive or negative and is automatically calculated by EasyMatch QC. When performing an additive hitch, the hitch standard should be very close in color to the samples you wish to measure using the hitch. For example, a reddish-orange standard should be used when measuring tomato products.

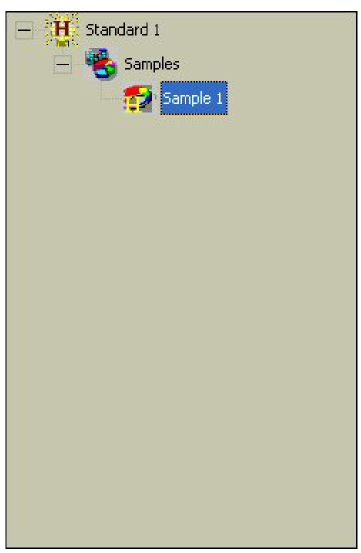
A **ratio hitch** is a ratio multiplier of the values measured using your instrument. The value displayed in the Color Data Table for each parameter (such as L, a, and b) is the measured value times the ratio value determined by the hitch standard. The ratio value is automatically calculated by EasyMatch QC. The ratio hitch is slightly more robust than the additive hitch for measuring samples of varying colors.

8. Choose the color scale and illuminant/observer for which you have hitch standard measurements. We happen to have CIELAB values using D65/10°. Type the assigned values into the cells next to the word "Target" and click **OK** twice. In this case, type in 94.00 for L*, -1.00 for a*, and 1.00 for b*.



Note: When using a tristimulus hitch you should enter hitch values using the same illuminant/observer as you wish to use for measurements. The software cannot calculate measurement values for a different illuminant/observer when a tristimulus hitch is being used.

9. Read the samples you wish to adjust according to the hitch, associating them with the standard you just hitched. Samples on the branches for other standards will not be hitched. If, at any time, you wish to stop using the hitch associated with this standard, simply access the Hitch Readings to Standard screen again, and check the box next to "Disable Hitch Temporarily." The items that are hitched will be shown in the Job Tree with a special "H" icon to indicate that they are hitched.

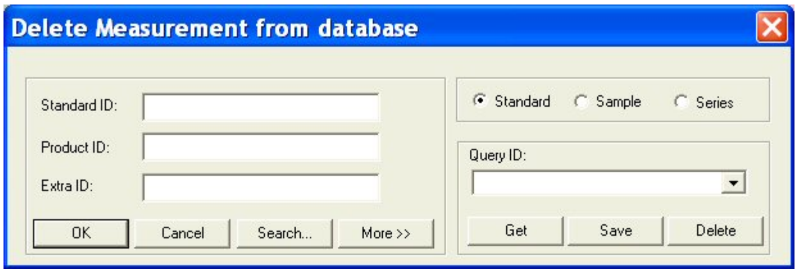


Note: Geometric differences between instruments cause differences in measured values, as can differences in sample preparation. Hitch standardization is recommended for use only among instruments with the same geometry and using a set procedure for sample preparation.

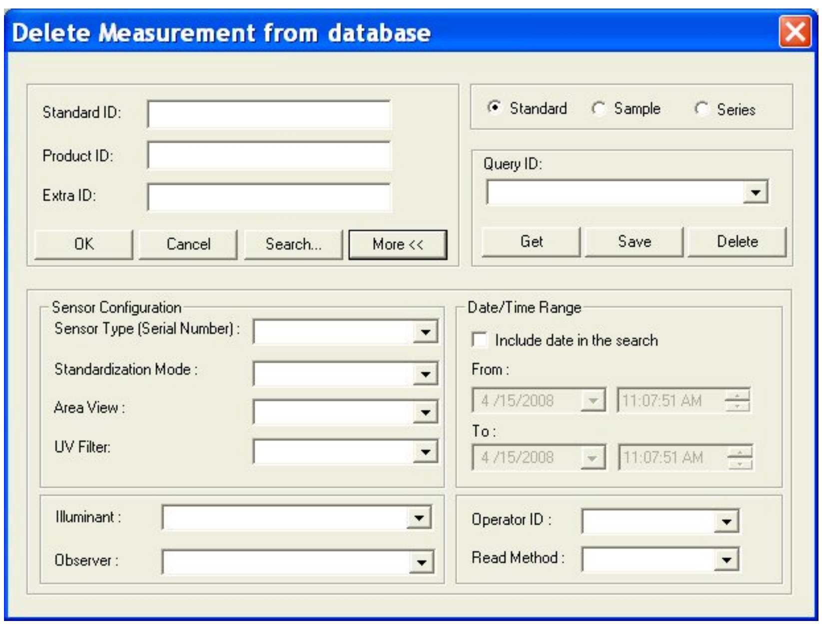
Lesson 5: Querying the Database to Recall or Delete Data

Suppose you wish to periodically delete all samples in the database that are more than two weeks old and were measured using the RSIN standardization mode. This lesson will step you through creating a query that you can use over and over to find and delete these samples.

1. Choose **Delete Measurement From Database** from the **File** menu. The following screen will be shown.



2. You cannot select the dates you want to delete or the standardization mode you wish from this screen, so click **More** for more options. The screen will expand to show the following:



3. First, click the radio button next to "Sample," so that you will find samples only, not standards or series.

4. Click (check) the box next to "Include date in the search."

5. Click the date drop-down in the "From" area to obtain a calendar on which you may select the starting date for the search. The calendar starts out with today's date marked. Since we wish to delete all samples that are more than two weeks old, the starting date can be somewhat arbitrary. Choose January 1, 2004, which is a date before EasyMatch QC was released.

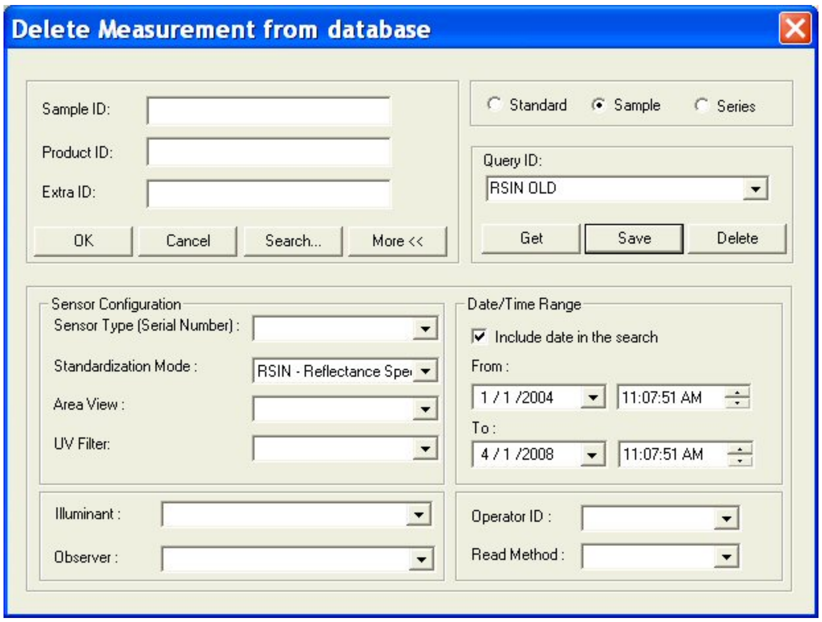
6. Click the date drop-down in the "To" area to obtain a calendar on which you may select the ending date. As before, today's date will be shown initially. Since we want to delete samples read two or more weeks ago, simply click on the date of two weeks ago.

7. We will not change the selected times, which are both the current time.

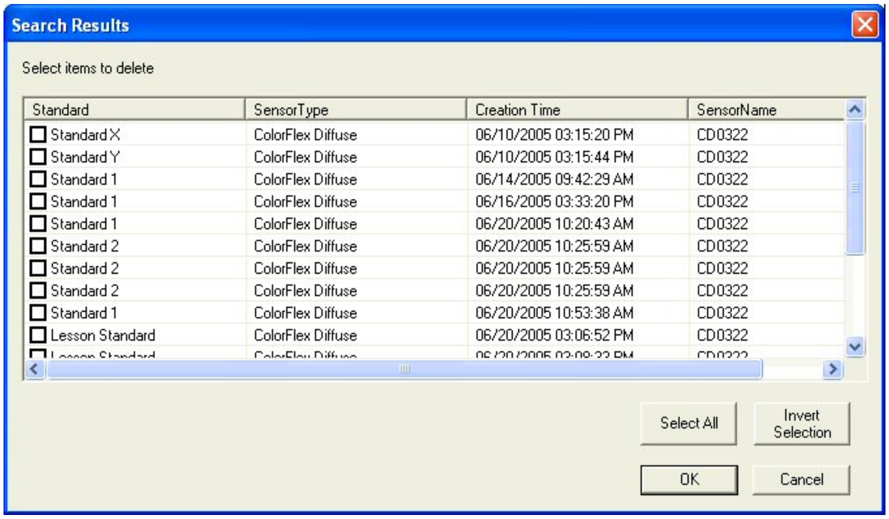
8. Our other query parameter is that the standardization mode be RSIN. Go down to the Standardization Mode box and select RSIN from the drop-down list. If you are using a ColorFlex, LabScan XE, ColorQuest 45/0 LAV, MiniScan XE Plus, or MiniScan EZ, choose Reflectance instead.

9. We will name and save these query parameters so that you can use them again later. Click on the box under Query ID and type a name for this query. Let's call this one "RSIN OLD."

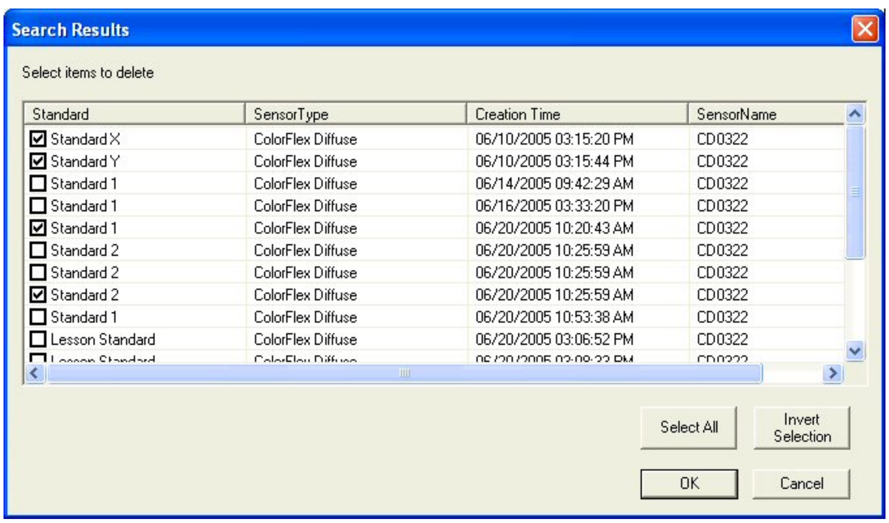
10. Click the **Save** button to save the RSIN OLD query. Do not type into or make any choices in any other fields on this screen or your query will be further limited. Your "Delete measurement from database" screen should then look like the one below, except that your dates will be different.



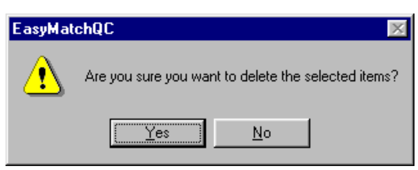
11. Click **OK** to use the query to find the samples to be deleted. (Your samples will not really be deleted at this point, just located.) The Search Results screen will show the samples located.



12. At this point you can examine the samples located and change your mind if you wish to keep any of them. You can click any of the column headers to sort the list on that column. Click (check) the box next to each sample you wish to delete. (While performing this exercise, you will probably not want to delete these samples, however.) Click **OK**.



13. You will be given one more chance to change your mind about deleting the samples with the screen shown below. Click **Yes** to continue with the deletion.



14. In order to delete samples periodically after the RSIN OLD query is set up, choose **Delete Measurement From Database** from the **File** menu again and then choose the RSIN OLD query from the drop-down list under Query ID. Click **Get** to then recall the query parameters.

15. Since time will have passed since the last time you used this query, you will need to change the "To" date on the query. The "From" date need not be changed. Open the calendar for the "To" date and choose the date of two weeks ago. Click **OK** to display the samples to delete.

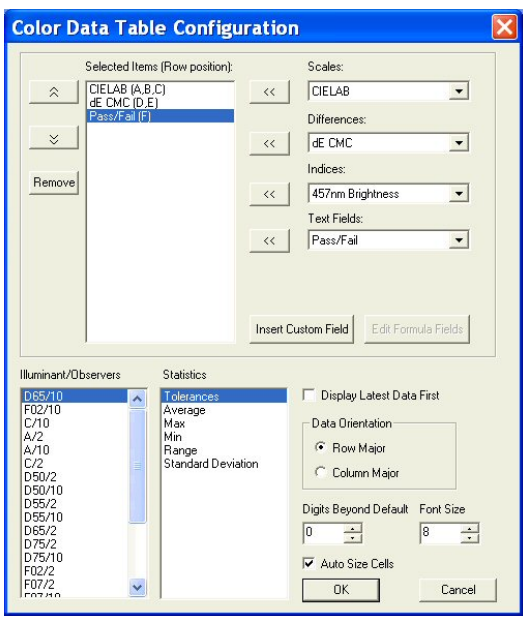
Data to be displayed in your job (not deleted) can be recalled in a very similar fashion. Simply choose **Recall Measurement From Database** from the **File** menu rather than **Delete Measurement From Database**.

Lesson 6: Using the Autotolerancing Feature

CMC autotolerancing can be used to automatically fit a CMC ellipsoid to a standard and to calculate CIE L*a*b*, CIEL*C*h, or Hunter L, a, b tolerances for that standard based on the size and shape of that ellipsoid. In this lesson, we will set up a job and a standard so that autotolerances will be calculated and used for that standard.

1. Open a new job and configure it to include a Color Data Table with the following specifications. See Lesson 1 if you need help.

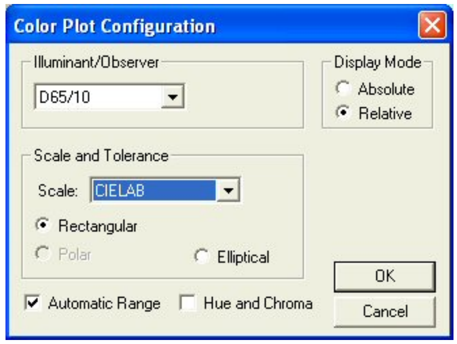
Scale	CIELAB
Differences	dE CMC
Indices	None
Text Fields	Pass/Fail
Illuminant/Observers	D65/10
Statistics	Tolerances
Data Orientation	Row Major
Digits Beyond Default	0
Font Size	8
Auto Size Cells	Checked



2. Configure the job to include a 2D Color Plot with the following specifications:

Illuminant/Observer	D65/10
Display Mode	Relative
Scale and Tolerance	CIELAB, Elliptical
Automatic Range	Checked

Hue and Chroma Unchecked

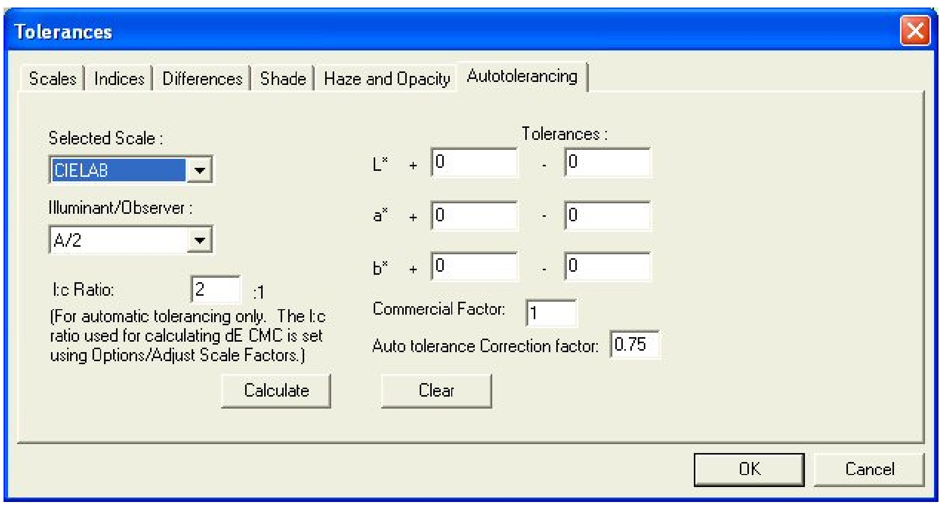


3. Standardize the instrument and then read your standard. Name the standard however desired.

4. Right-click on the standard in the Job Tree and choose **Properties** from the menu that appears.

5. On the Standard Properties screen that appears, click the **Tolerances** button.

6. On the Tolerances screen, click the **Autotolerancing** tab.

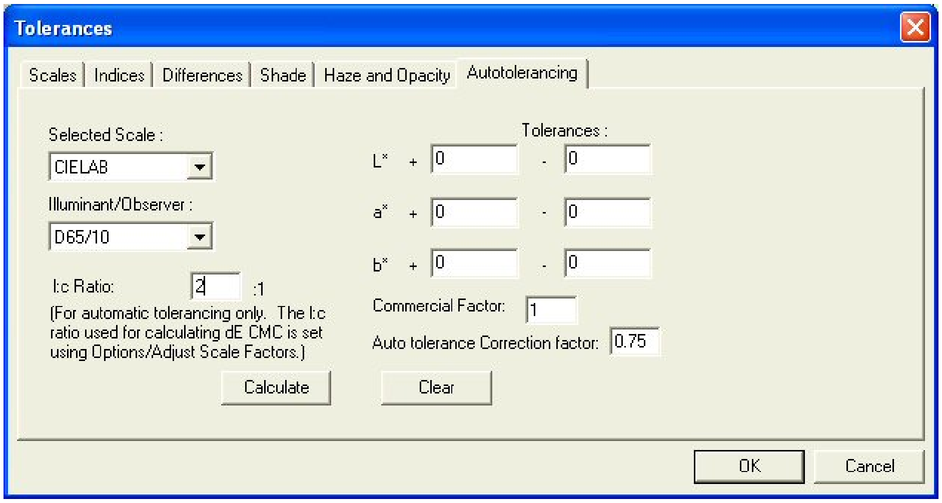


7. Under Selected Scale, select CIELAB to match the color scale we selected for the Color Data Table and 2D Color Plot. Also select the D65/10 illuminant/observer combination to match those selected for the Color Data Table and 2D Color Plot.

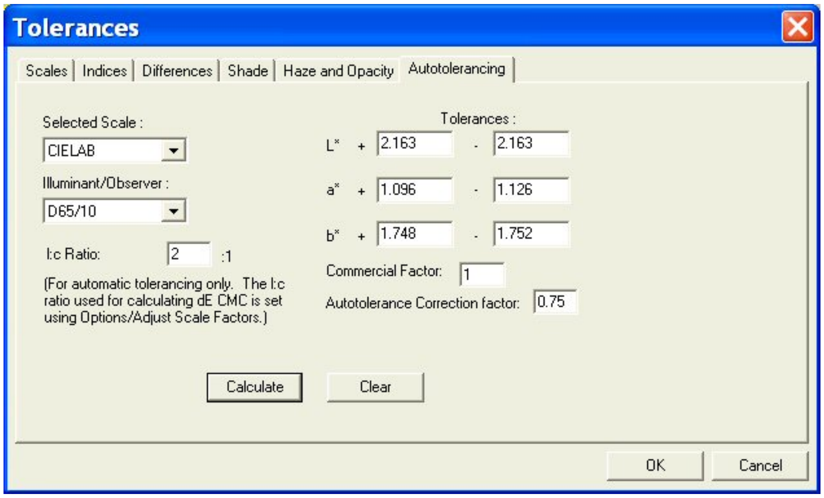
8. Enter 2:1 for the l:c ratio. This is the default value used for CMC calculations in the textile industry. Your industry may suggest a different value.

9. Enter 1 for the Commercial factor. This is the default value used to represent one unit of just perceptible difference, but this value may be adjusted to tighten or loosen the tolerance, as desired.

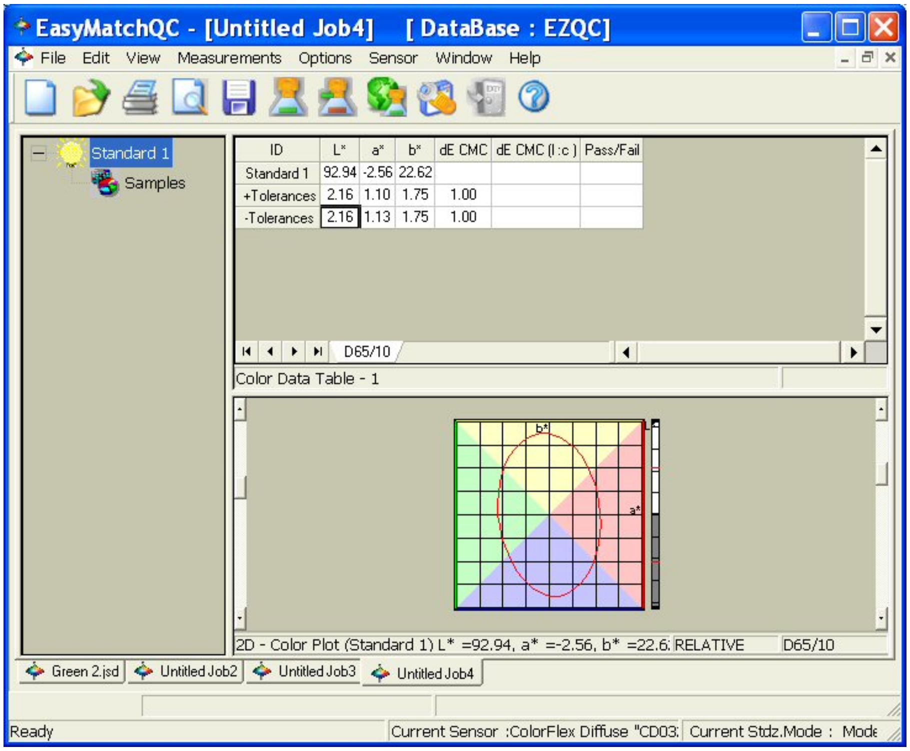
10. Enter 0.75 for the Auto tolerance Correction factor. This is the default value used to estimate the percentage of the tolerance box that is taken up by the CMC ellipsoid (excluding the 25% of the box volume that does not overlap with the ellipsoid). This value may be adjusted to tighten or loosen the tolerance, as desired. (A value of 1 would estimate the entire volume of the tolerance box, including those areas outside the CMC ellipsoid.)



11. Click the **Calculate** button. The L*a*b* D65/10° tolerances for this standard are automatically calculated and shown in the Tolerances boxes.



12. Click **OK** twice to accept the tolerances. You will now see the tolerances in your Color Data Table and 2D Color Plot for this standard.



13. Save the job and save the standard to the database. The automatically-generated tolerances will also be saved.

14. You may now read samples to be compared to this standard.

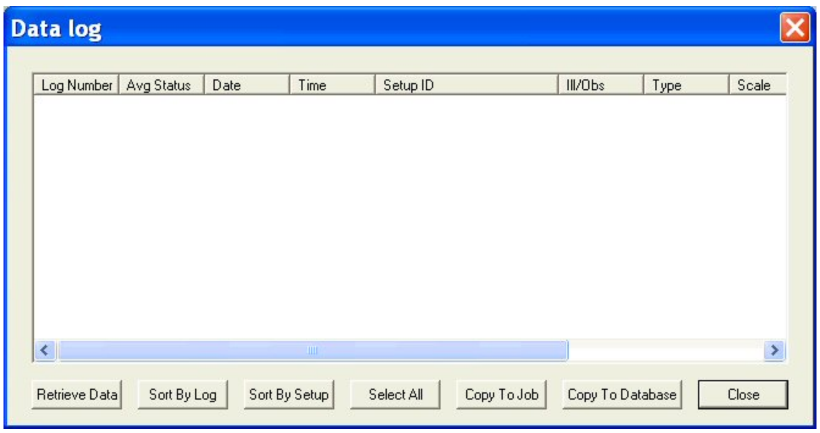
Lesson 7: Sharing Data and Setups with a ColorFlex, MiniScan XE Plus, or MiniScan EZ

In order to upload samples from your ColorFlex, MiniScan XE Plus, or MiniScan EZ datalog to EasyMatch QC, you must have data saved to the instrument datalog as SPECTRAL data or ABSOLUTE TRISTIMULUS data. See your instrument's User's Guide for information about using a spectral datalog (configured in the Instrument Setup) and measuring absolute data (configured in the Product Setup). When you are ready to upload your data, perform the following steps:

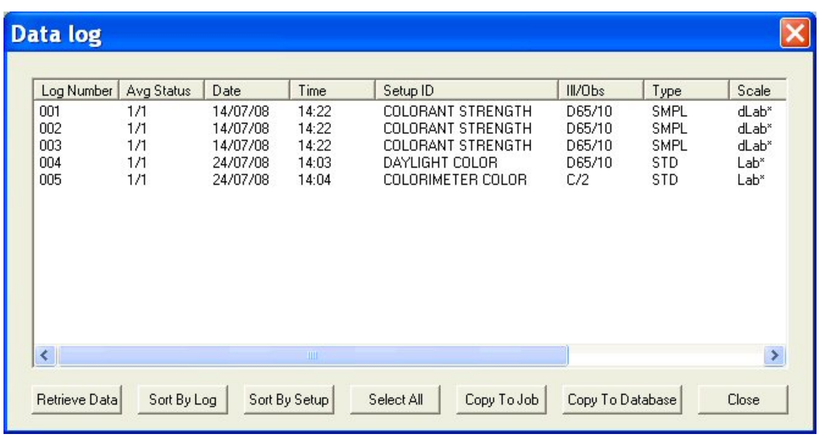
1. Connect the ColorFlex, MiniScan XE Plus, or MiniScan EZ to your computer and install it in EasyMatch QC. See the Sensor Menu chapter and Chapter 11 for more information.

2. Open an EasyMatch QC job and configure it as desired. You may modify the views later as long as SPECTRAL or ABSOLUTE TRISTIMULUS data is being uploaded.

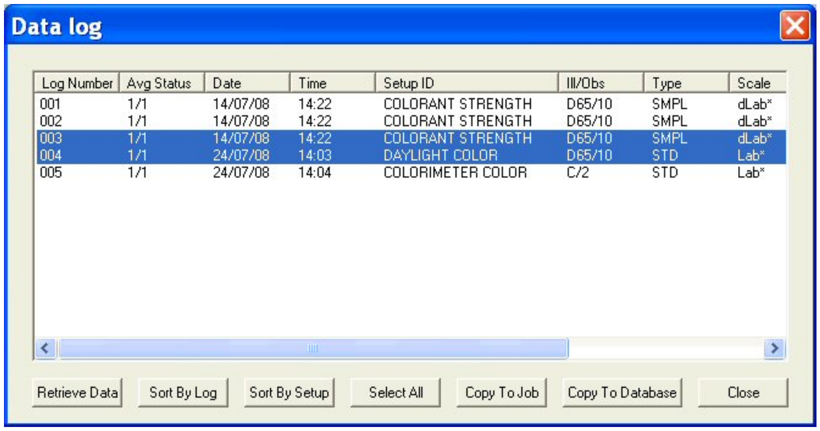
3. Choose **Import Logged Reads** from the **Sensor** menu. The following screen appears.



4. Click **Retrieve Data**. The measurements stored in the instrument datalog will be uploaded and displayed on the Data log screen. A status screen will be displayed as the data uploads.



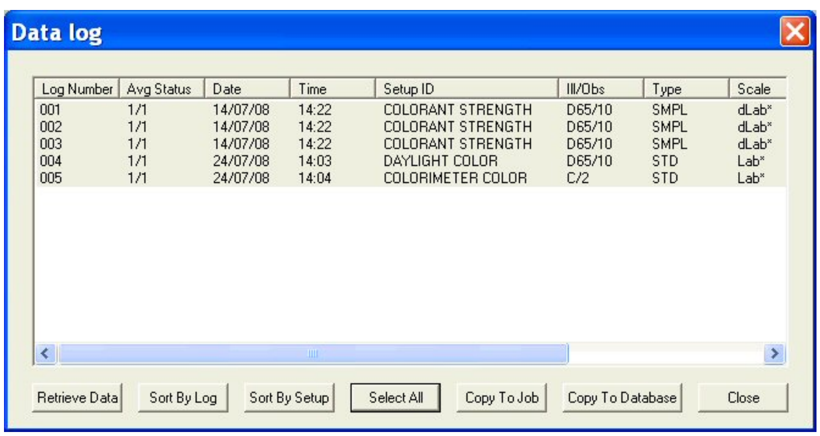
5. Suppose, after examining the data, you wish to show Log Numbers 003 and 004 in your job. The other data will not be displayed in the job, but you don't mind. Click on 003 and then hold the **Ctrl** key on your keyboard and click on 004 so that those samples are highlighted.



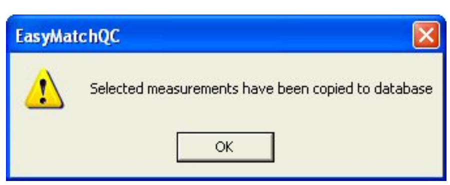
6. Click **Copy to Job**. These measurements are copied into your job. Standards are copied into the job as standards. Samples are copied as samples, and you are given the opportunity to indicate the standard with which you would like to link each. The Data log screen remains open.

Note: If you attempt to copy a ColorFlex or MiniScan XE Plus DIFFERENCE TRISTIMULUS sample into the job, the message "Difference data cannot be retrieved from the data log when it is in tristimulus mode" will be received and the sample will not be copied into the job. This is because the software does not know what standard values were used to calculate the sample's difference data.

7. Suppose you wish to copy all of the measurements into your database for later use. Click **Select All**. All of the measurements will be highlighted.



8. Click **Copy to Database**. The measurements are saved in the EasyMatch QC database.

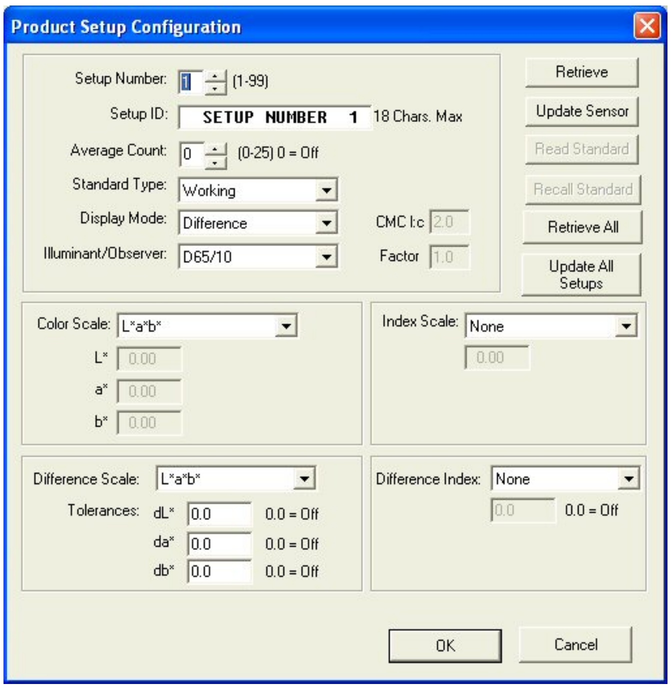


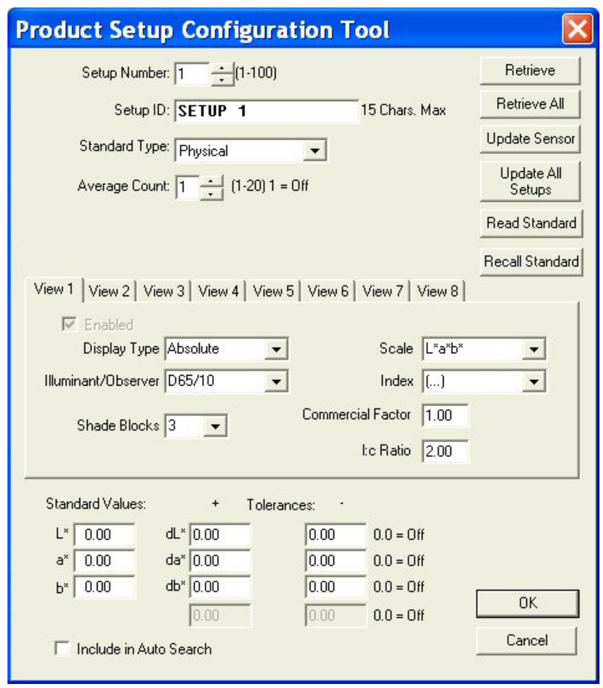
9. Click **Close** to close the Data log screen.

Suppose you then want to modify one of your instrument Product Setups while the instrument is still connected to your computer. Complete the following steps:

1. Select **Configure Setups** from the **Sensor** menu. The following screen appears.

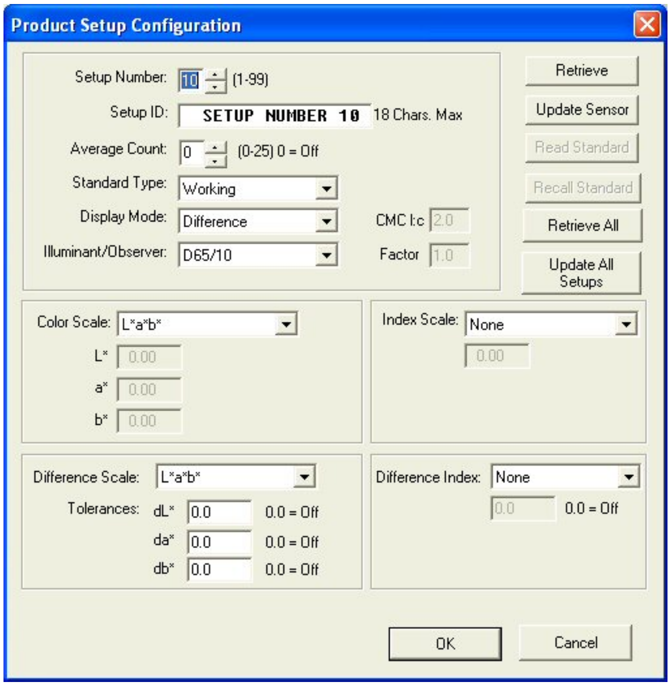
2. Since you wish to edit one setup, click **Edit**. The Product Setup Configuration screen appears.

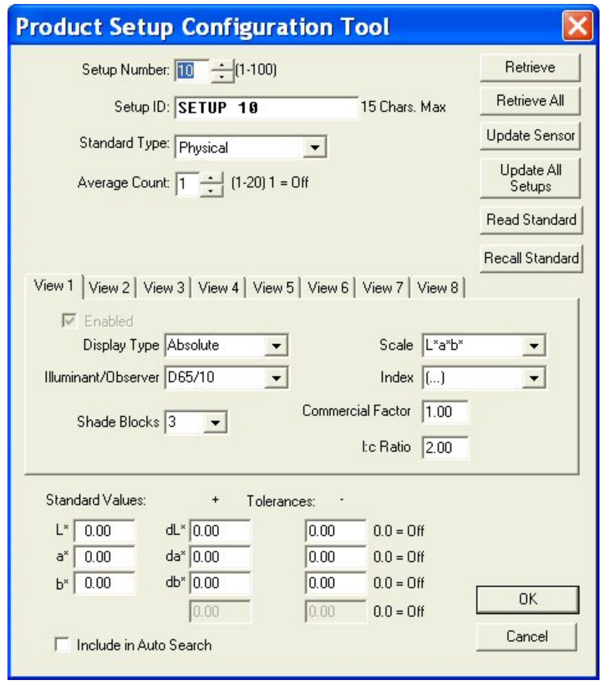




ColorFlex and MiniScan XE Plus | **MiniScan EZ**

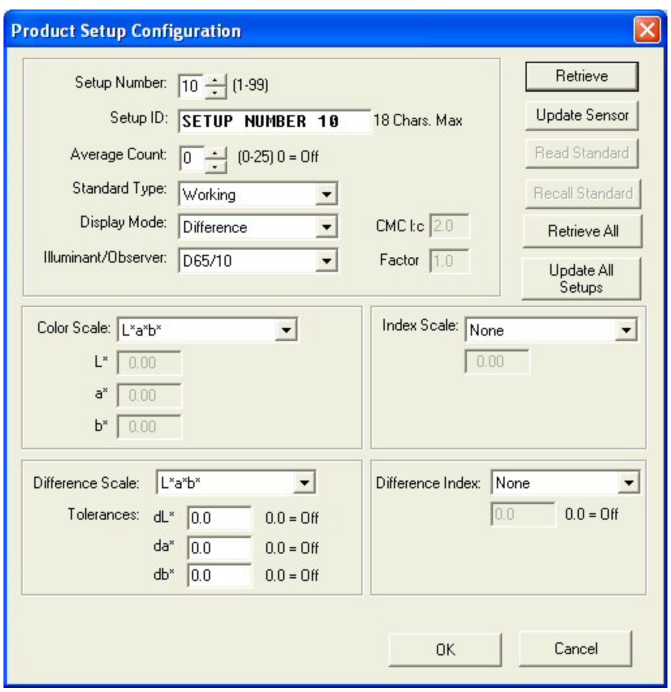
3. The setup you wish to modify is number 10. Click the up arrow next to Setup Number until the number 10 is shown.

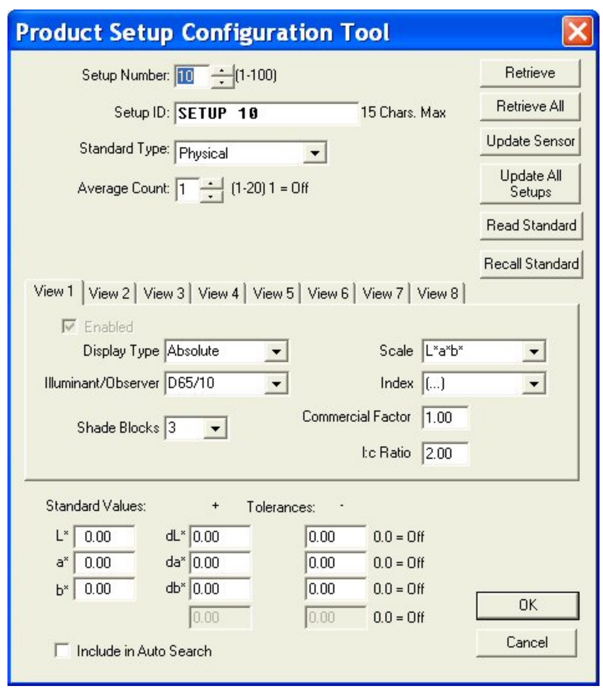




ColorFlex and MiniScan XE Plus **MiniScan EZ**

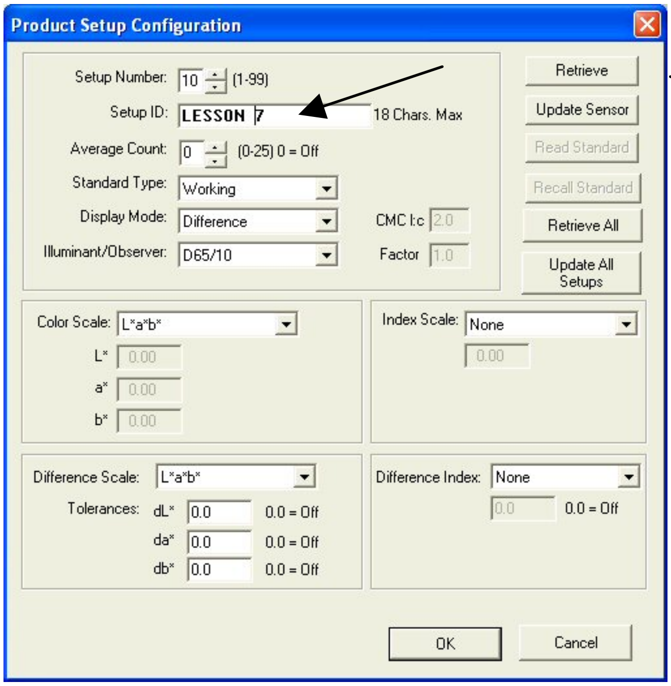
4. Click the **Retrieve** button. The parameters that are currently stored in your instrument for Setup Number 10 are brought into the Product Setup Configuration screen.



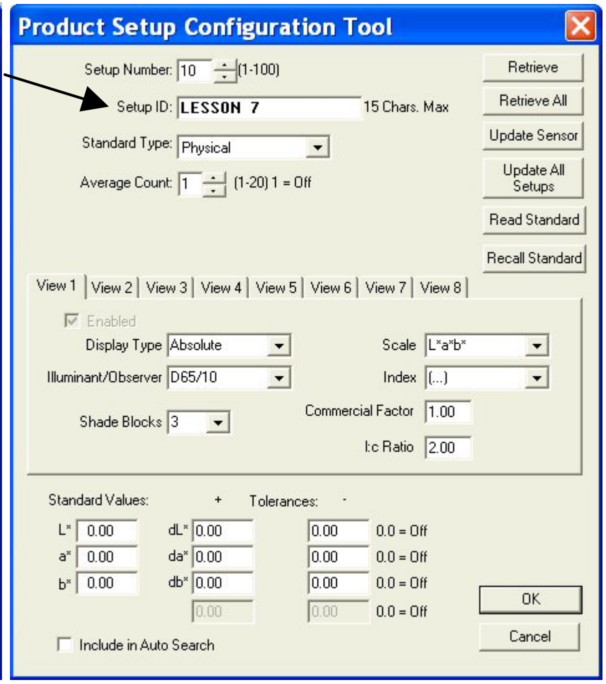


ColorFlex and MiniScan XE Plus **MiniScan EZ**

5. Highlight the ID currently shown in the Setup ID box and replace that ID by typing "LESSON 7."

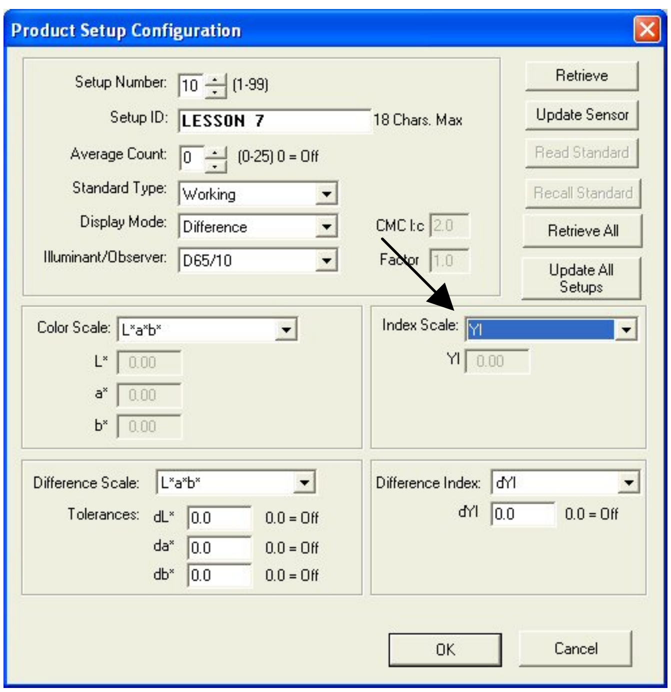


ColorFlex and
MiniScan XE Plus

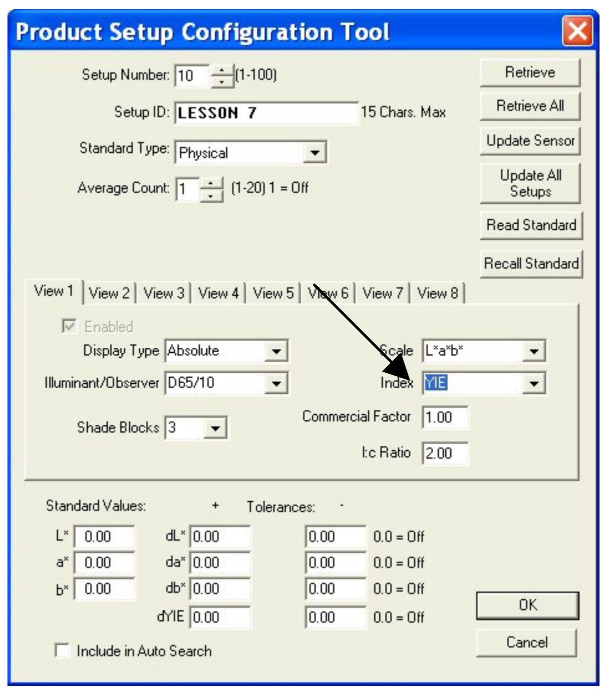


MiniScan EZ

6. Select YI (YIE for MiniScan EZ) from the drop-down box next to Index Scale.

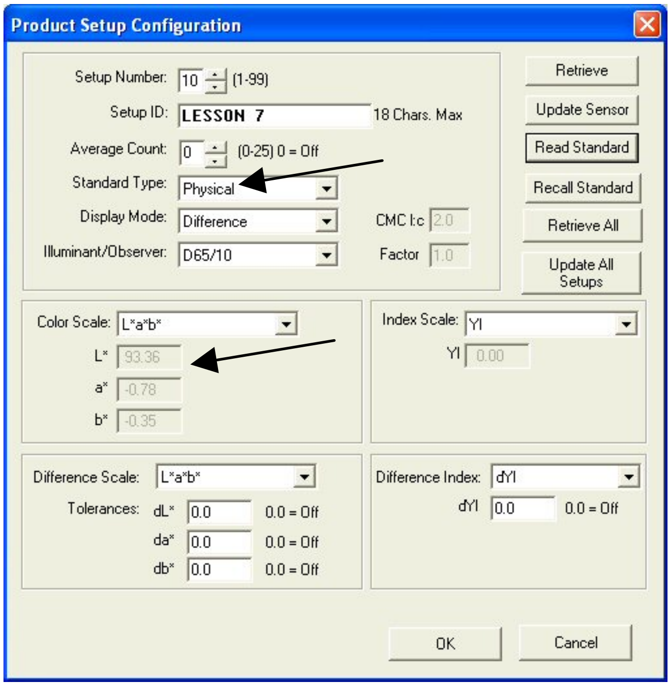


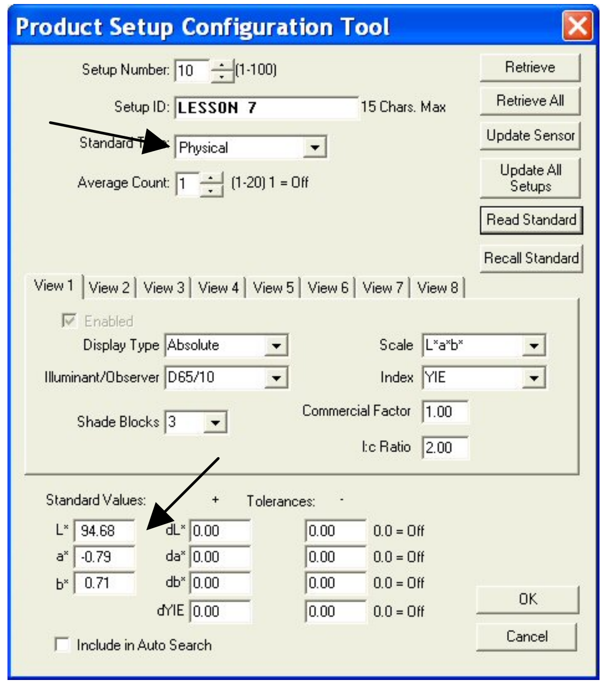
ColorFlex and
MiniScan XE Plus



MiniScan EZ

7. Select Physical from the drop-down box next to Standard Type. Center your product standard at the sample port and click the **Read Standard** button. The standard is measured and its values placed in the boxes beneath Color Scale.





ColorFlex and MiniScan XE Plus | **MiniScan EZ**

8. Your setup has now been modified as desired on your computer screen. Click the **Update Sensor** button. The altered setup is sent to your instrument. Observe the change on your instrument's display.

9. Click **OK** to exit the Product Setup Configuration screen and then **Done** to exit the Setup Groups screen.

Lesson 8: Using Custom Data and Formula Fields

Suppose you are measuring liquids with your spectrophotometer to assess color, and you also use a pH meter to assess the pH of each liquid. It would be wonderful if you could show the color values and the pH for each sample on one printout. In this lesson, we will configure a custom data field and enter a pH value for one of the samples as an example. Your supervisor has also asked for a special calculation to be performed on these samples, called pH Lightness, which is equivalent to the entered pH + L* value for each sample using the C/2 illuminant/observer. In the second half of this lesson, we will add a custom formula field to calculate and display pH Lightness.

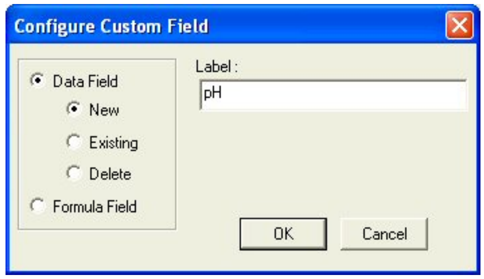
1. Open the desired job and place a Color Data Table in it.

2. Configure the Color Data Table as follows. Refer to Lesson 1 if you need help. Do not close the Color Data Table Configuration screen after selecting these parameters.

Scales	CIELAB
Differences	None
Indices	None
Text Fields	None
Illuminant/Observers	C/2
Statistics	None
Display Latest Data First	Unchecked
Data Orientation	Row Major
Digits Beyond Default	2
Font Size	8
Auto Size Cells	Checked

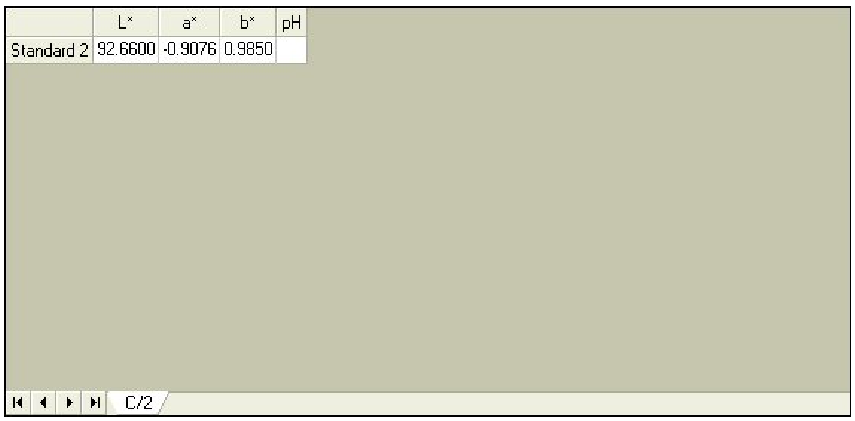
3. Click the **Insert Custom Field** button. The Configure Custom Field box appears.

4. Click the radio button next to Data Field and then the radio button next to New. Type "pH" into the Label box.



5. Click **OK**.

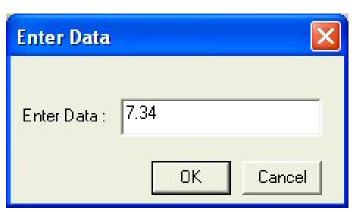
6. Add the "Data Fields" Text Field to the display and then **OK** from the Color Data Table Configuration screen. Note that the pH field has been added to the Color Data Table.



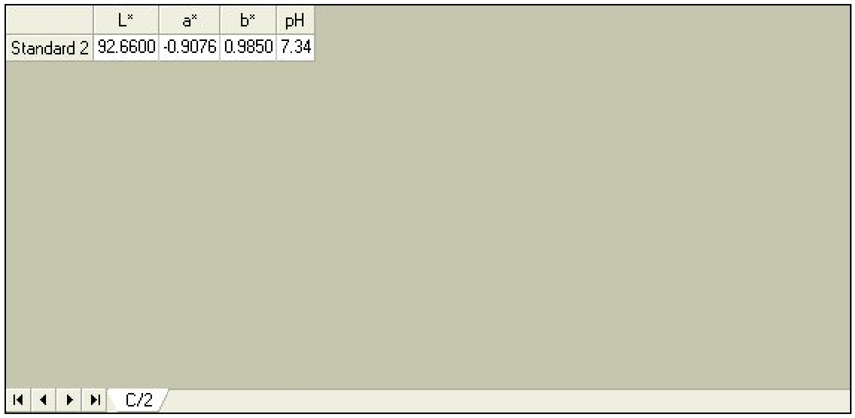
7. Read or recall some samples and standards into the job if there aren't already some present.

8. Select one item in the Job Tree and right-click on it. From the menu that appears, choose **Enter pH Data**. The Enter Data screen will be shown.

9. Enter the pH value for the selected sample or standard into the box.



10. Click **OK**. The entered data will be shown in the Color Data Table.

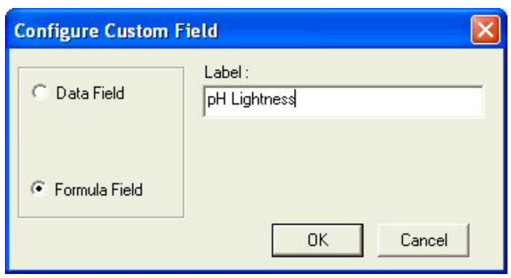


11. Enter pH values for more samples and standards if you wish.

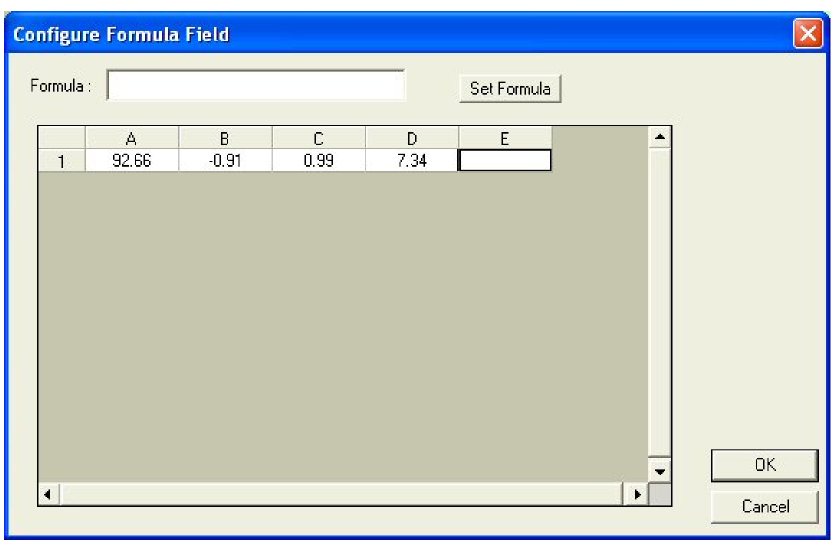
12. Right-click in the Color Data Table and return to the Color Data Table Configuration screen.

13. Click the **Insert Custom Field** button. The Configure Custom Field box appears.

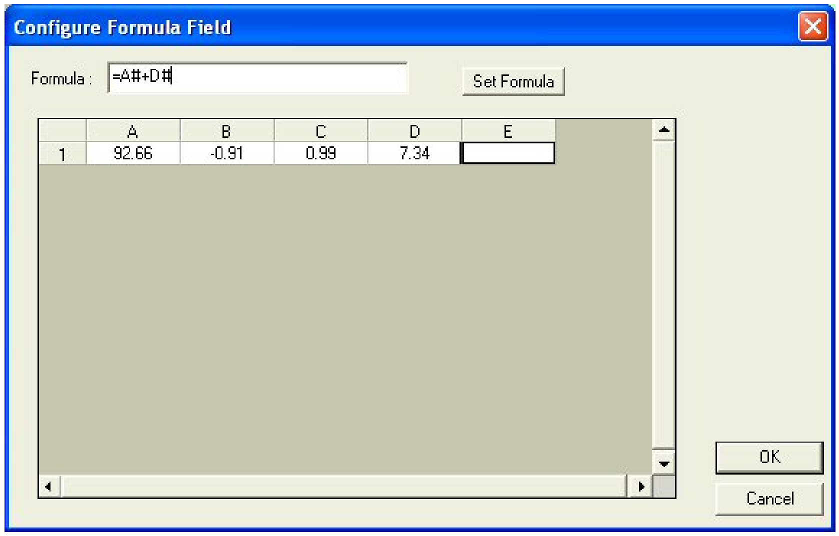
14. Click the radio button next to Formula Field. Type "pH Lightness" into the Label box.



15. Click **OK**. The Configure Formula Field box is shown.



16. Your custom formula will be inserted in column E, to the right of the pH you just entered. Place your cursor in the Formula box and type "=A#+D#" (without quotation marks). This indicates that the value in column E will be set to the value in column A (L*) plus the value in column D (pH).



17. Click **Set Formula**, then **OK**.

18. Add the "pH Lightness" Text Field to the display, then click **OK**. The formula fills the pH Lightness column for each displayed sample and standard.

Lesson 9: Setting Up a Print Job

You may choose to have the data displayed on your screen print in a specific fashion. Suppose you wish to configure a print job containing two pages of data, the first displaying the Color Data Table, 2D Color Plot, and Spectral Plot, and the second showing the Spectral Data Table. You would also like to show a header and footer on each page. Complete the steps below to configure and use the print job.

1. Access the properties page for your default printer. This is done by clicking the **Start** button and choosing **Printers and Faxes**. Right-click on your default printer and choose **Properties**. Consult Windows Help for more information.

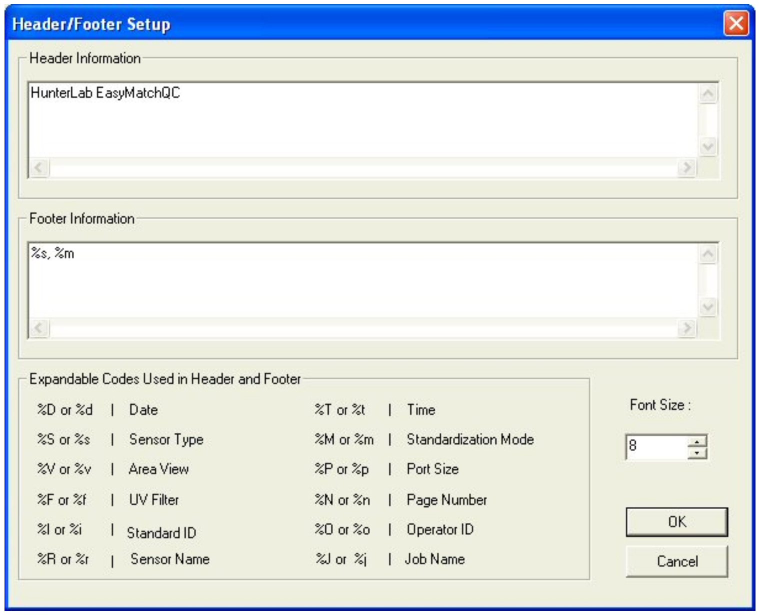
2. For the paper size and orientation for your printer, choose Letter (8 ½ x 11") and Portrait for use in this example. In the future, you may use any paper size and orientation you desire. Accept these settings and exit the printer properties pages.

3. In EasyMatch QC, choose **File/Configure Company Logo**. The Configure Company Logo screen appears.

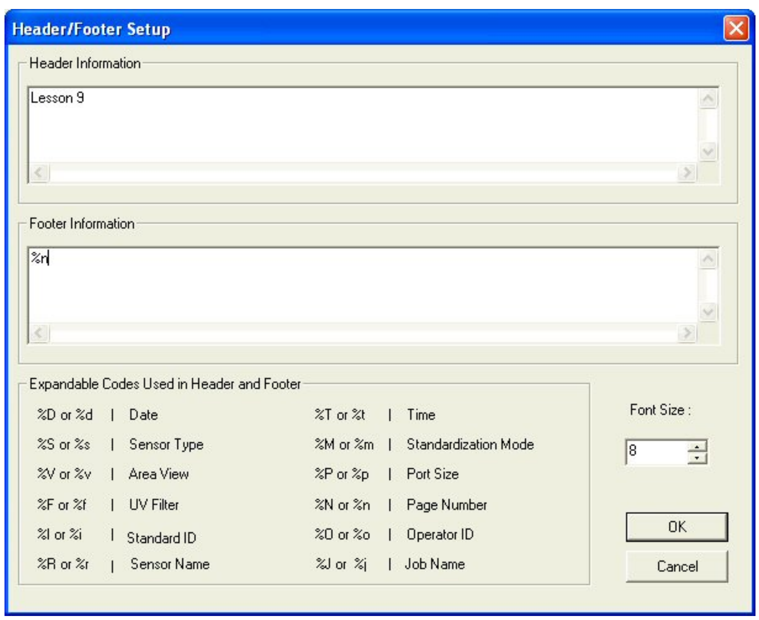
4. Use the "**...**" (browse) button to locate your company logo file. This file must be in bitmap (.BMP) format. Once you select the file, a preview will be shown so you can make sure you chose the proper file.

5. Click **OK** to exit the Configure Company Logo screen.

6. Choose **Header/Footer Setup** from the **File** menu. The Header/Footer Setup screen appears.

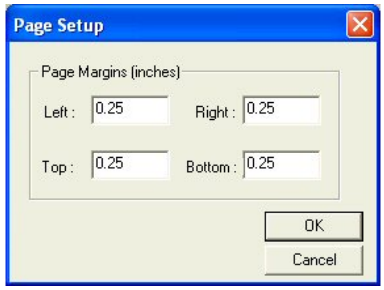


7. In the Header Information box, delete the current text and type in "Lesson 9" as your header text. In the Footer Information box, delete the current text and type in "%n" to use the page number as the footer. Increase the font size to 12.

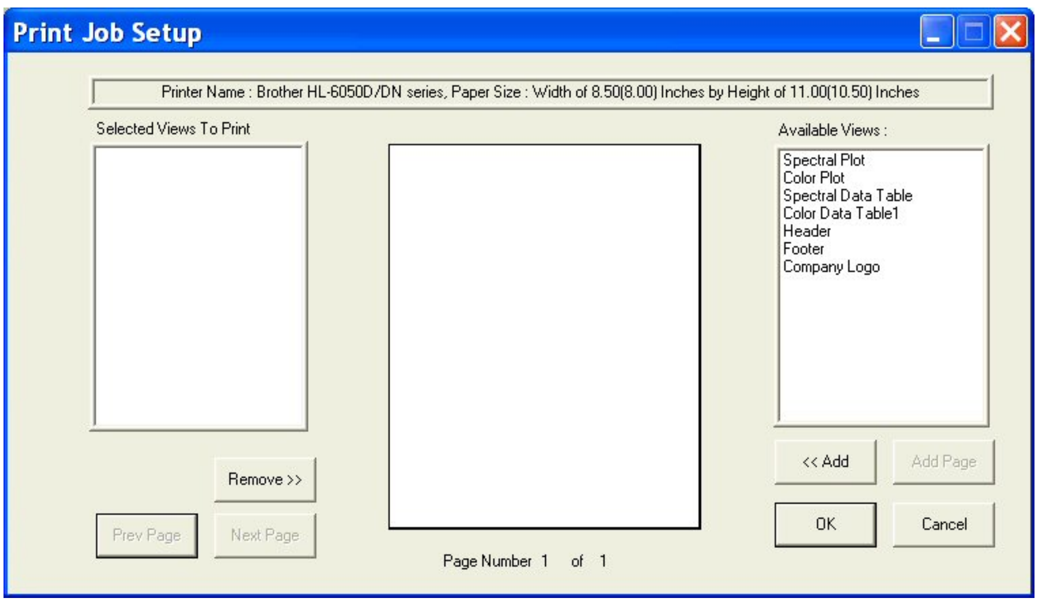


8. Click **OK** to accept the new header and footer.

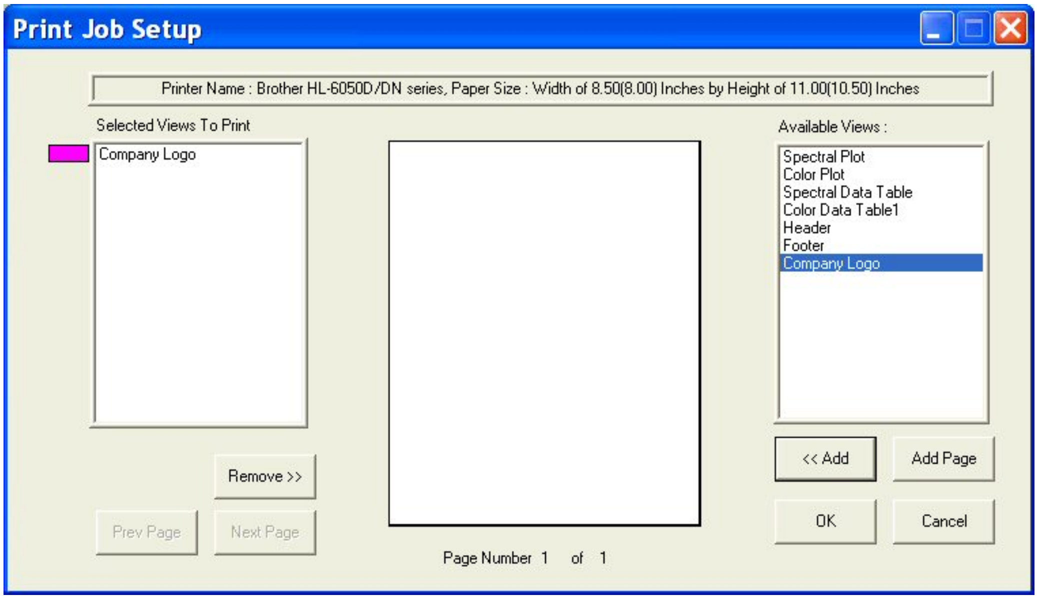
9. Choose **Page Setup** from the **File** menu. The Page Setup screen appears. Indicate the size of the margins you would like to leave at each edge of your paper. 0.25-inch (6.4 mm) is sufficient for most printers. Click **OK** to accept these margins.



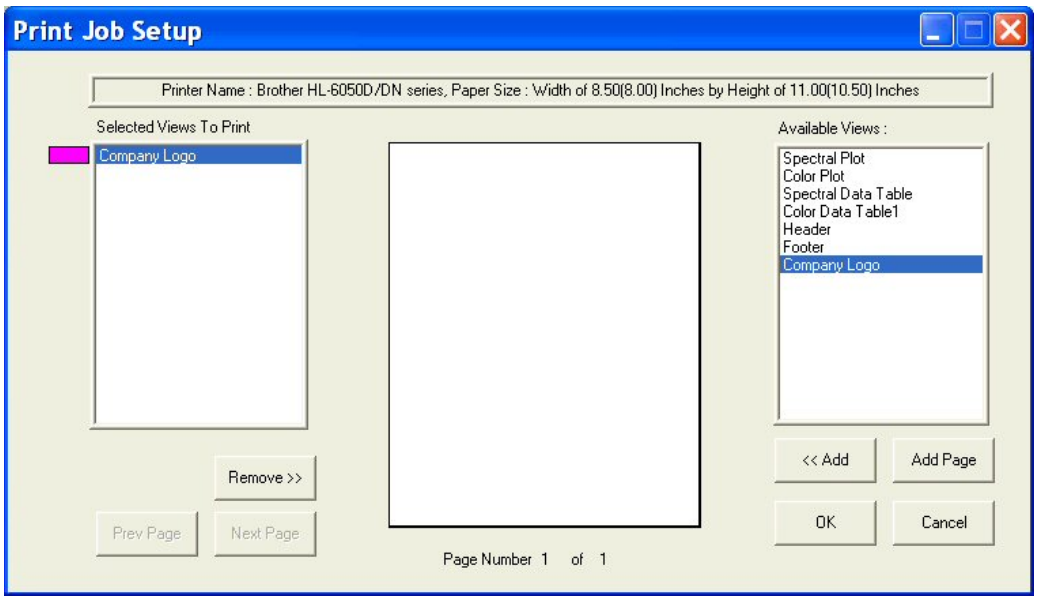
10. Choose **Print Job Setup** from the **File** menu. The Print Job Setup screen appears. Note that the name of the default printer and the dimensions of the page and the printable area on the page are indicated at the top of the screen. The data views listed under "Available Items" are the ones that are included in the current job, plus your company logo, header, and footer. If the Color Data Table, 2D Color Plot, Spectral Plot, and Spectral Data Table are not included in the current job, you will not see them in the list and you will not be able to add them to your print job. In that case, exit this screen and open a job containing all of these data views, or add the needed views to the current job.



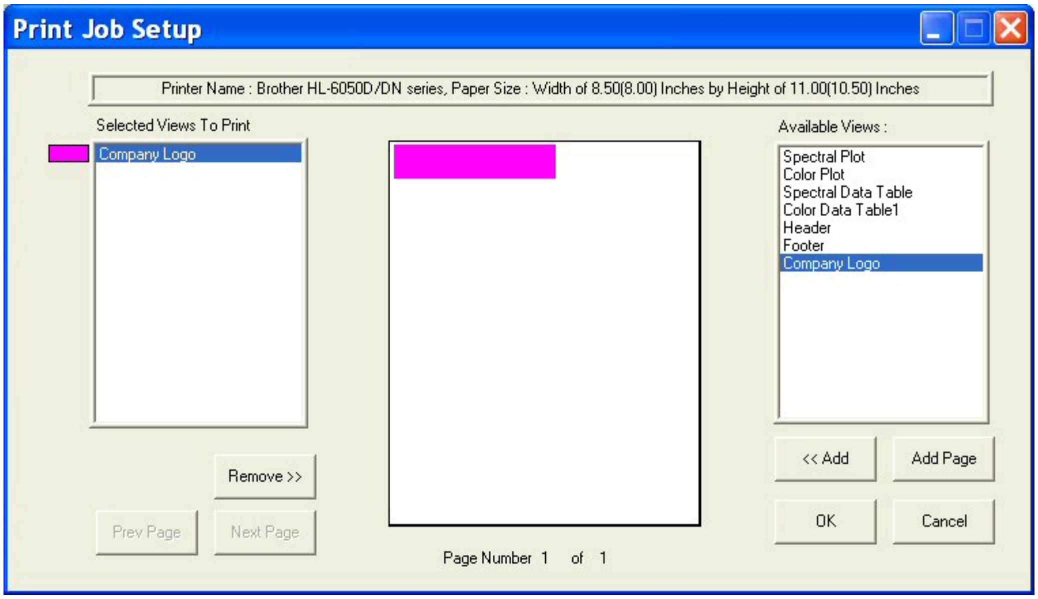
11. Insert your company logo by clicking on "Company Logo" in the Available Items box on the right side of the screen and then clicking the **Add** button. Company Logo is added to the Selected Items box on the left side of the screen.



12. Click on the Name "Company Logo" in the Selected Items box so that it is highlighted. Note the color that will be used to represent the logo (magenta in this example).

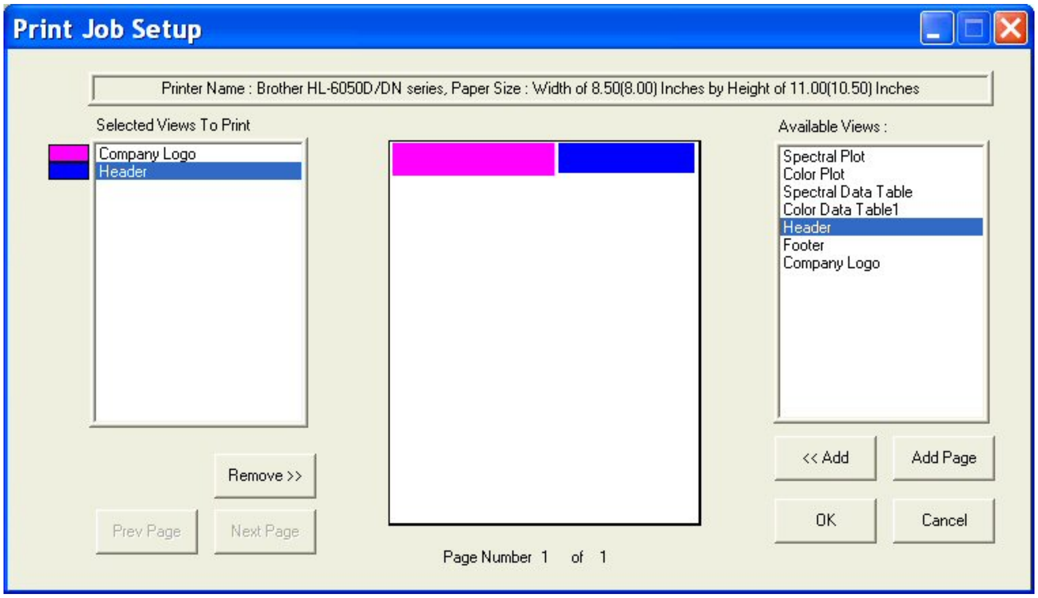


13. Move your mouse over the page representation in the middle of the screen. Click where you would like to locate one of the top corners of the logo box, drag the mouse across the page to where you would like to locate the opposite bottom corner of the logo box, and then release the mouse button. A magenta box will be shown on the page, indicating where the logo will be printed. If you make a mistake in your positioning or sizing, simply start over by clicking and dragging from the top corber again. The first box will be replaced by your corrected box.



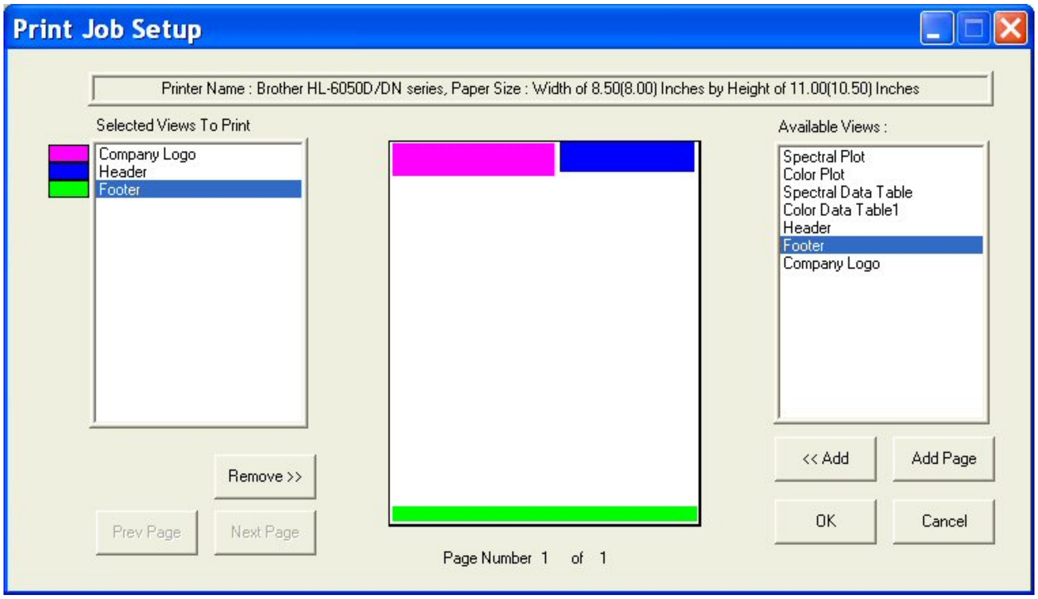
14. Highlight "Header" in the Available Items box and click Add to add a header to your printout.

15. Highlight Header in the Selected Items box and click and drag on the piece of paper to place the header on the page.

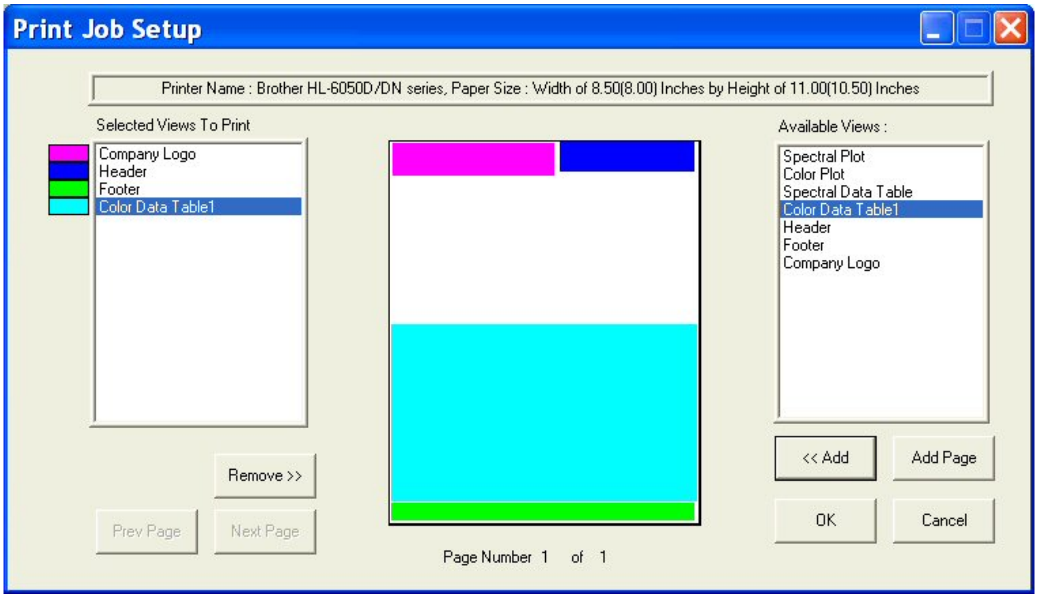


16. Highlight "Footer" in the Available Items box and click **Add** to add a footer to your printout.

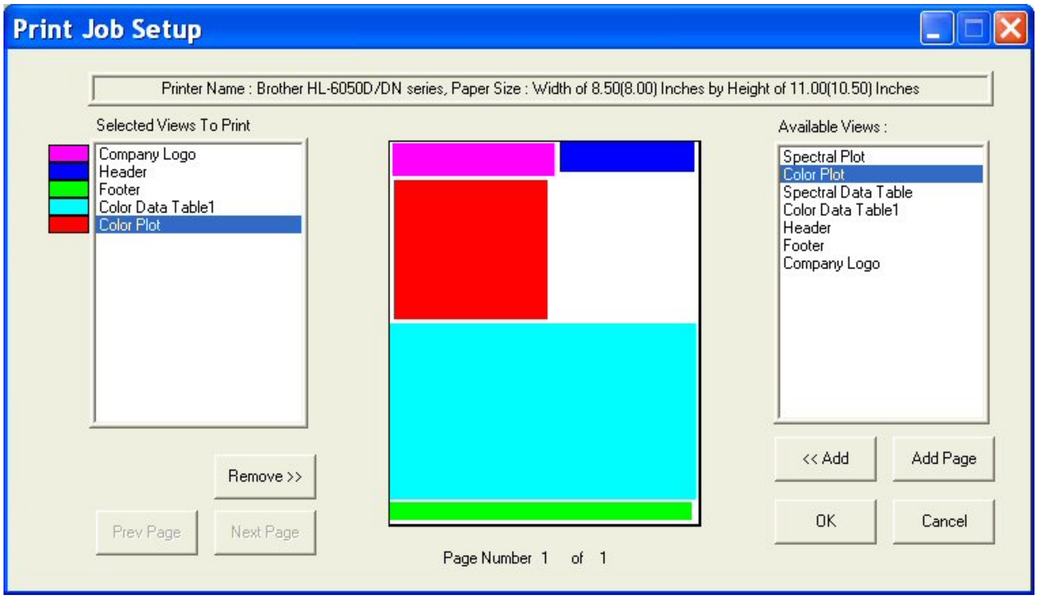
17. Highlight Footer in the Selected Items box and click and drag on the piece of paper to place the footer on the page.



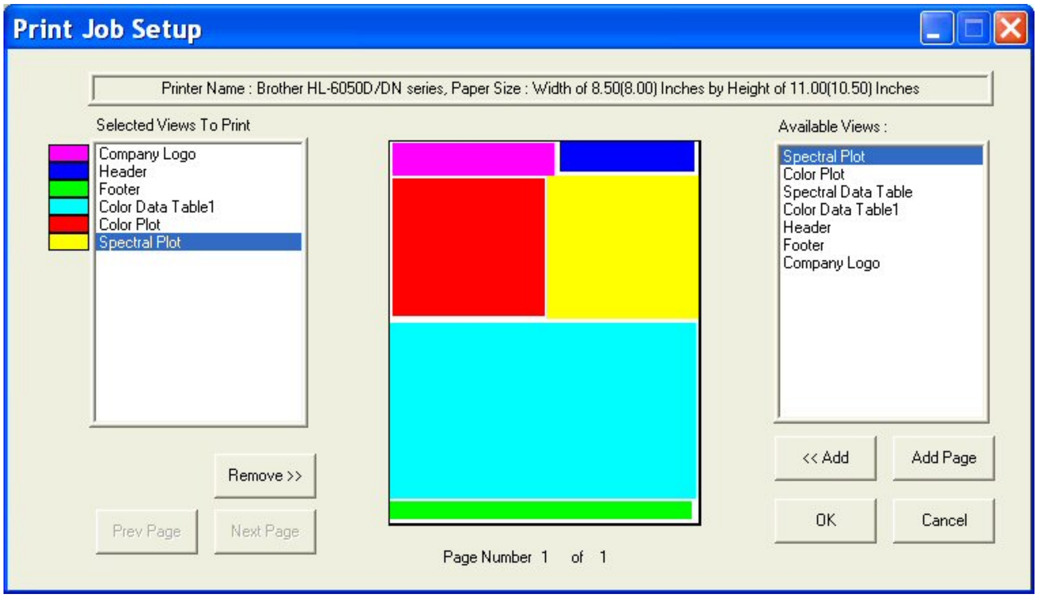
18. Add the Color Data Table to the display across the bottom half of the page.



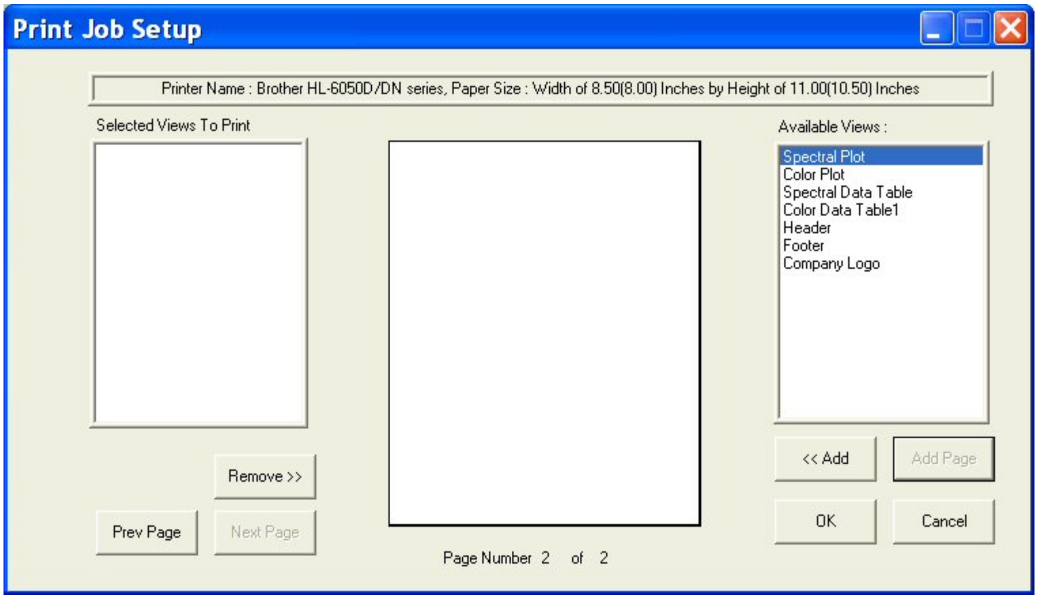
19. Add the 2D Color Plot to the printout in the left half of the remaining blank space.



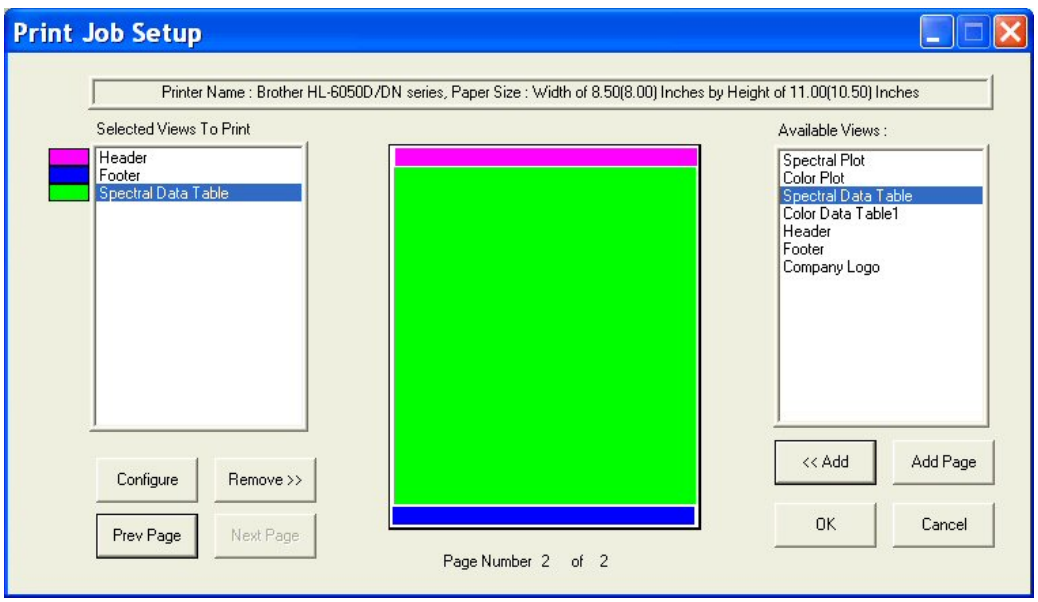
20. Add the Spectral Plot to the printout in the remaining blank space. The completed print layout for the first page of your printout appears as follows:



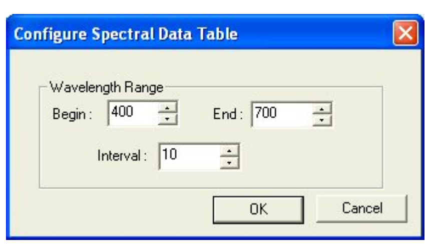
21. Click **Add Page** to add the second page to your report. You will receive a blank page on the Print Job Setup screen. Also, the Page Number indicator at the bottom of the screen will change to "Page Number 2 of 2" and the **Prev Page** and **Next Page** buttons will activate.



22. Add the header and footer to your page, and then fill the rest of the page with the Spectral Data Table. The completed print layout for the second page of your printout appears as follows:



23. Click the **Configure** button.



24. The screen that appears allows you to select the spectral range that will be printed on this page in the area you just designated for the Spectral Data Table. Many times, the data for the entire available spectral range of the instrument will not fit on one page. In that case, you may select one range to be

printed on this page (i.e., 400-550 nm) and then add and configure a Spectral Data Table on another page to print the rest of the range (i.e., 560-700 nm). Click **OK** to accept this spectral range.

25. Click **OK** to exit the Print Job Setup screen.

26. Configure your data views as you desire to view them both on your computer screen and on your printout. If you need help, refer to Lesson 1.

27. Read or recall the sample and standards you wish to view and print and select (highlight) them in the Job Tree.

28. Choose **Print Job** from the **File** menu. Your two report pages will print to your Windows default printer.

*Note: If data views are truncated or overlap, adjust the sizes and positions for your data views as needed. You may also change the font for spreadsheets using the **Configure** command in the right-mouse menu for the Color Data Table and Spectral Data Table. The optimal print job setup will vary for each printer brand and model, as well as for the number of samples displayed and your data view configurations.*

Lesson 10: Obtaining Shade Numbers

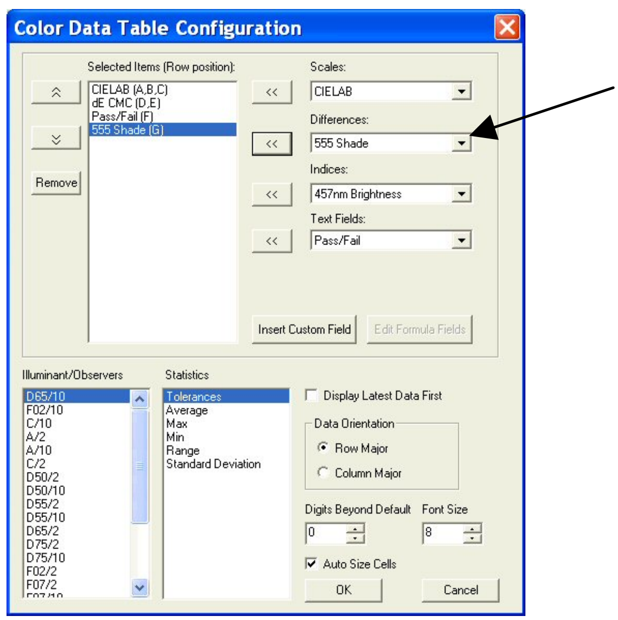
Shade numbers provide a convenient way of sorting samples into groups of similar color. This is helpful in situations where several separate pieces will be combined into a whole and the colors of the pieces must be closely matched.

In order to use shade numbering, you must first read or recall an ideal product standard into your job then enter your desired tolerances for the standard. These tolerances will provide the borders on which your shade blocks will be based. Autotolerancing may be used to calculate these tolerances if desired, but manually-entered tolerances work just as well. In this lesson, we will demonstrate both methods.

1. Open the job you created and saved in Lesson 6.

2. Click on the standard created in Lesson 6 and look at the Color Data Table to confirm that the automatically-generated tolerances are listed there. Write down the tolerances for L*, a*, and b*.

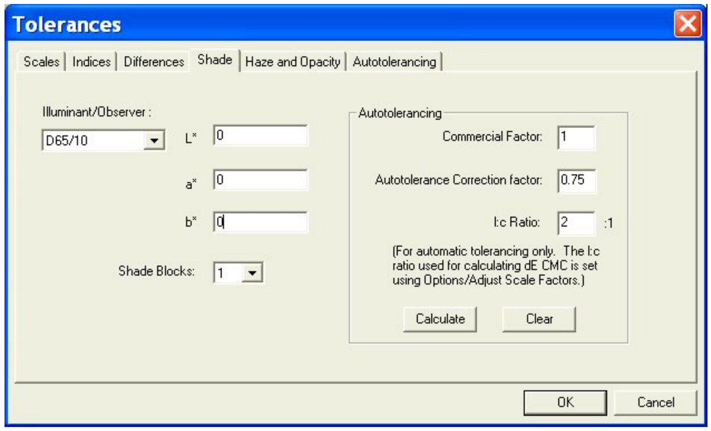
3. Open the Color Data Table Configuration and add the "555 Shade" Difference to the display.



4. Right-click on the standard in the Job Tree and choose **Properties** from the menu that appears.

5. On the Standard Properties screen that appears, click the **Tolerances** button.

6. On the Tolerances screen, click the **Shade** tab.



7. Drop down the box next to Shade Blocks and select the number of shade blocks you wish to have fit inside your tolerance. For this lesson, select 5.

8. Look at tolerances you wrote down in Step 2. If the positive and negative values for each parameter (L*, a*, and b*) do not match exactly, calculate the average of the two.

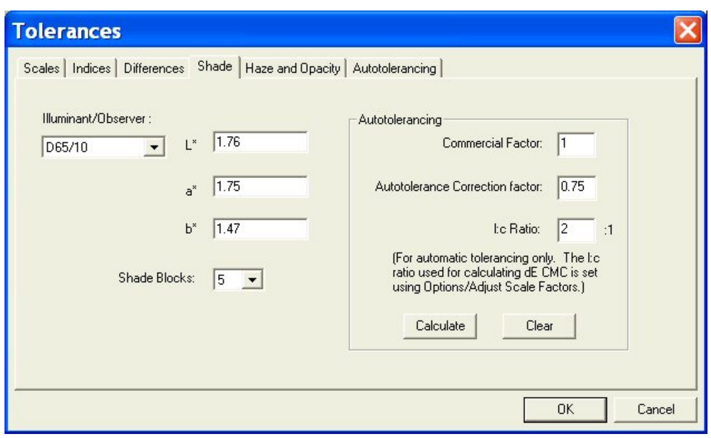
Note: If we had not already automatically generated tolerances for this standard in Lesson 6, you could do so now on the ***Shade*** *tab by clicking the* ***Calculate*** *button.*

9. Enter the average number for L* into the First Trace tolerance box.

10. Enter the average number for a* into the Second Trace tolerance box.

11. Enter the average number for b* into the Third Trace tolerance box.

Note: Do NOT divide your overall tolerance by the number of shade blocks. The software will do this for you.



12. Click **OK** twice to accept the shade tolerances. They will not be shown in your Color Data Table, but will be used in calculating the shade numbers that will be displayed for each sample read.

13. Read a sample that is close in color to the standard and link it with the standard for which we just altered tolerances. Its shade number will be displayed along with its color values.

ID	L*	a*	b*	dE CMC	dE CMC (l:c)	Pass/Fail	555 Shade
Standard 1	92.94	-2.56	22.62				
+Tolerances	2.16	1.10	1.75	1.00			0
-Tolerances	2.16	1.13	1.75	1.00			0
Sample 1	93.18	-2.52	22.51	0.11	2.00 : 1.00	Pass	555

D65/10

14. Read another sample, one that is further from the standard that the first one and link it to the same standard. Once the data is displayed in the Color Data Table, click the 555 Shade column header to sort the measurements based on their shade numbers.

ID	L*	a*	b*	dE CMC	dE CMC (l:c)	Pass/Fail	555 Shade
Standard 1	92.94	-2.56	22.62				
+Tolerances	2.16	1.10	1.75	1.00			0
-Tolerances	2.16	1.13	1.75	1.00			0
Sample 2	92.54	-3.20	21.92	0.76	2.00 : 1.00	Pass	544
Sample 1	93.18	-2.52	22.51	0.11	2.00 : 1.00	Pass	555

D65/10

15. Read a new standard.

16. Apply L*, a*, and b* tolerances (D65/10) of ±1 to this standard for each parameter of the color scale.

17. Also enter shade tolerances of this value (1) for L*, a*, and b* for this standard and choose to use 5 shade blocks.

18. Read a sample and link it to this new standard.

19. Observe the shade number for this sample in the Color Data Table.

ID	L*	a*	b*	dE CMC	dE CMC (l:c)	Pass/Fail	555 Shade
Standard 2	92.57	-3.15	22.02				
+Tolerances	1.00	1.00	1.00	1.00			0
-Tolerances	1.00	1.00	1.00	1.00			0
Sample 3	92.41	-3.15	22.05	0.06	2.00 : 1.00	Pass	455

D65/10

Save the job and save each standard to the database. The new tolerances will be saved with each standard.

Lesson 11: Using a Data Series

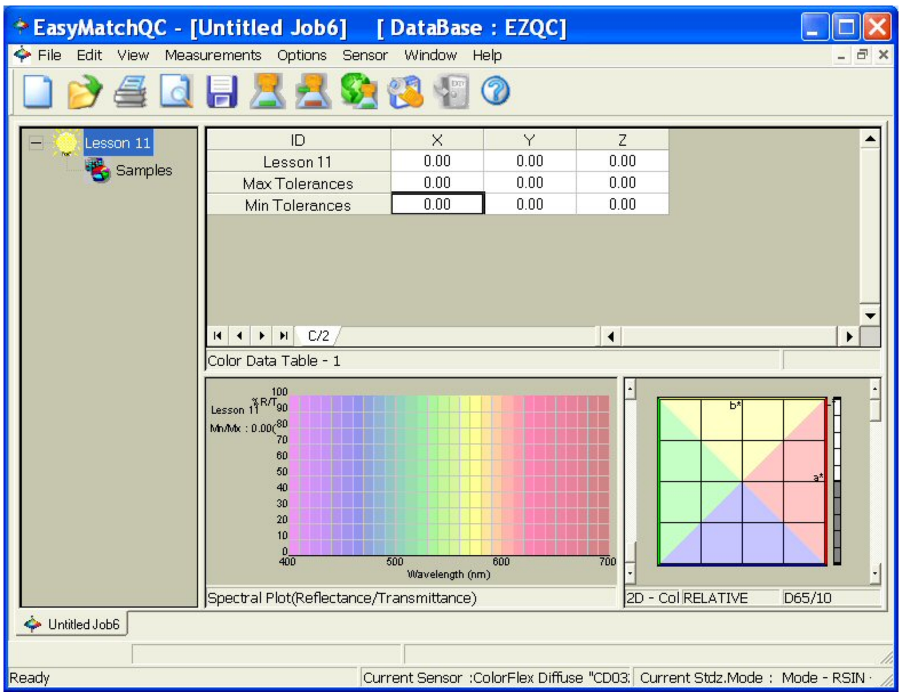
Suppose an ideal physical standard does not exist for your product, so you cannot read this standard with your instrument and then compare samples from your process with this standard. However, you do have a general product specification available such as the following:

X (C/2) must be between 75 and 85
Y (C/2) must be greater than 80
Z (C/2) must be less than 70.

We can use a data series to input these product specifications and then compare samples to it as if it were a standard.

1. Open a new job and configure the Color Data Table to display XYZ for C/2 and to show tolerances. You may configure the other parameters however you like.

2. Open the **Measurements** menu and choose **Read Series**. Name the series "Lesson 11." Note that the X, Y, and Z values for the data series are all zero.



3. Right-click Lesson 11 in the Job Tree and choose **Properties**.

4. Click **Tolerances**.

5. On the **Scales** tab, choose XYZ for the scale and C/2 for the illuminant/observer and then enter the tolerances that correspond with your product specifications.

   X Min = 75

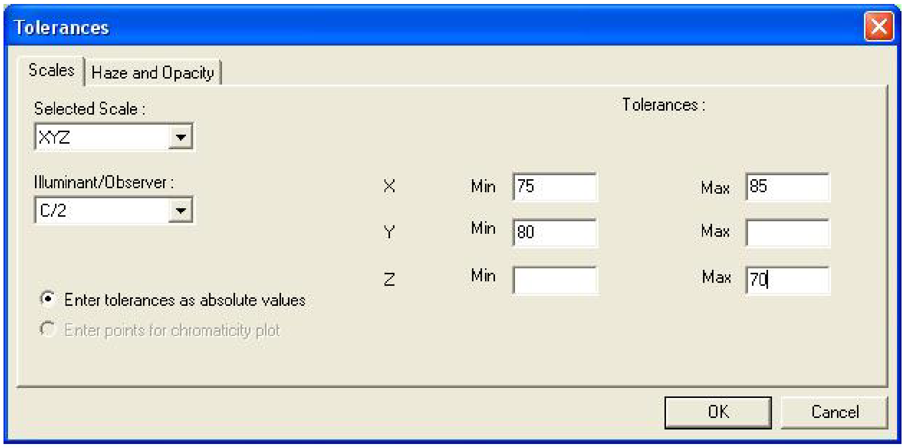
   X Max = 85

   Y Min = 80

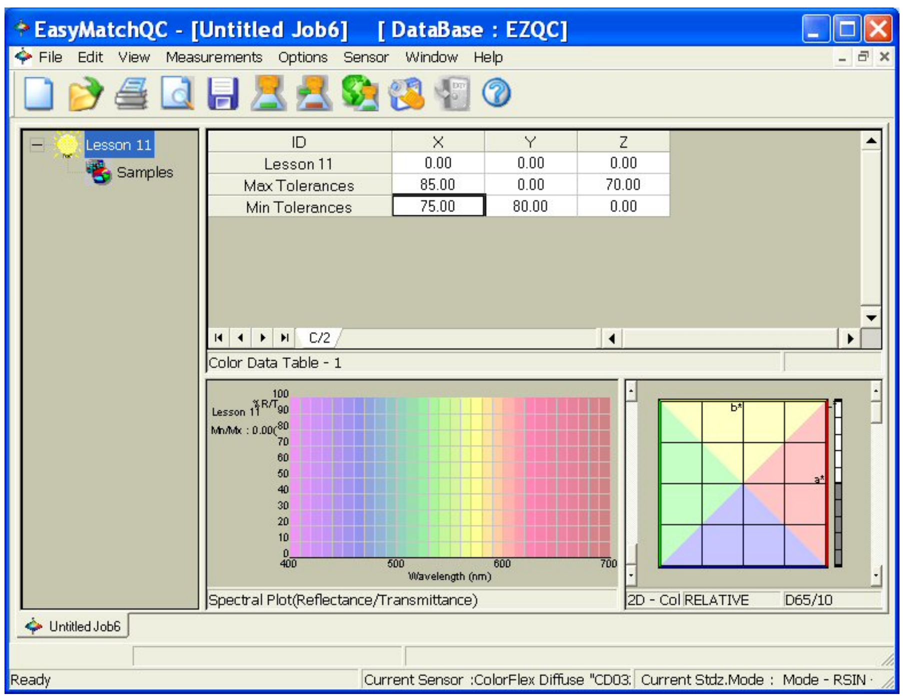
Y Max = No maximum value

Z Min = No minimum value

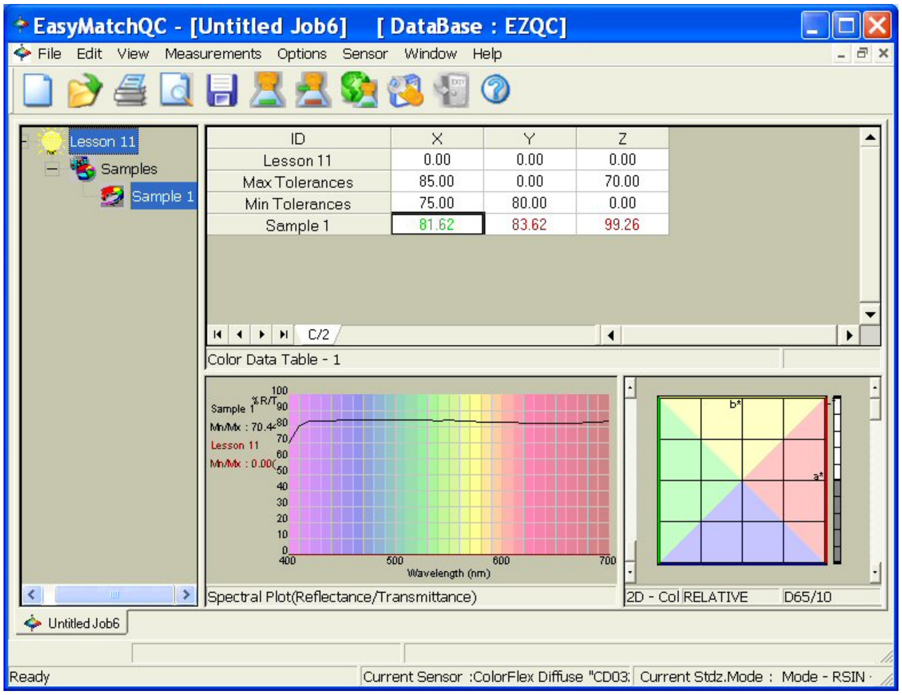
Z Max = 70.



6. Click **OK** twice to exit the Tolerances screen and the Series Properties screen. The minimum and maximum values entered now show in the tolerance rows of the Color Data Table.



7. Read a sample and link it to the Lesson 11 series. It will be assessed versus the minimum and maximum tolerances and pass (green)/fail (red) reported.


EasyMatchQC - [Untitled Job6] [DataBase : EZQC]
File Edit View Measurements Options Sensor Window Help
Lesson 11
Samples
Sample 1
ID X Y Z
Lesson 11 0.00 0.00 0.00
Max Tolerances 85.00 0.00 70.00
Min Tolerances 75.00 80.00 0.00
Sample 1 81.62 83.62 99.26
C/2
Color Data Table - 1
Wavelength (nm)
Spectral Plot(Reflectance/Transmittance)
2D - Col RELATIVE
D65/10
Untitled Job6
Ready
Current Sensor :ColorFlex Diffuse "CD03:
Current Stdz.Mode : Mode - RSIN

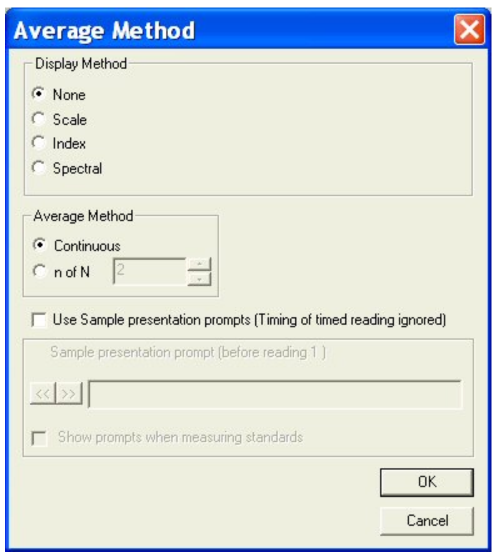
Lesson 12: Averaging Readings

Suppose you are measuring a sample, such as corduroy, which is very directional. You've decided that the best way to measure it, taking its directionality into account, is to make four readings of the sample, rotating the fabric 90° between readings so that the instrument looks at it from all directions. The four readings will be averaged into the final result, which you will report. Configure the averaging and read the sample as described below.

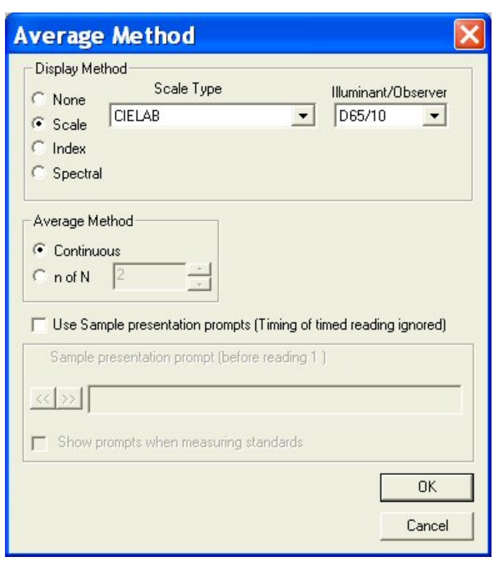
1. Open a new job and configure its Color Data Table to display CIELAB for D65/10°. You may configure the other parameters however you like.

2. Open the **Measurements** menu and select **Average** so that it is checked.

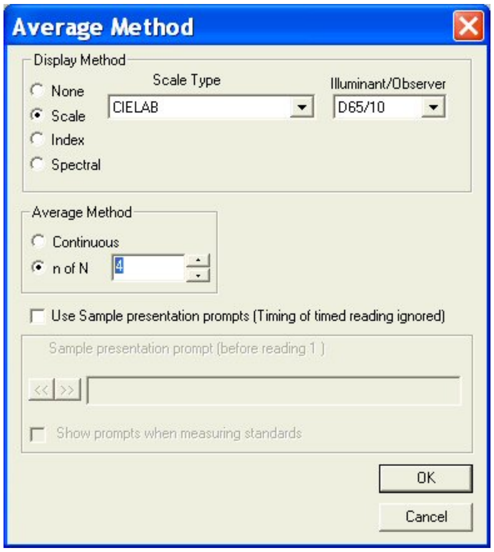
3. Open the **Options** menu and select **Average Method**. The Average Method screen appears.



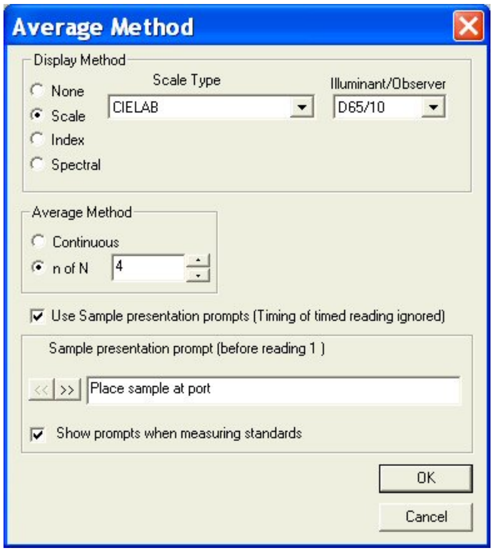
4. In the Display Method area, click the radio button next to Scale and choose CIELAB as the Scale Type and D65/10 as the Illuminant/Observer. This ensures that the data shown on the Average Reading screen uses the same parameters you are displaying in your Color Data Table.



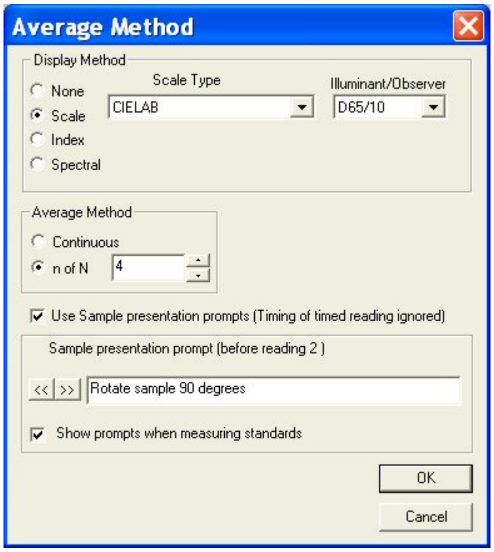
5. In the Average Method area, click the radio button next to n of N and select 4 as the number of readings to average.



6. At the bottom of the screen, check the boxes next to both "Use Sample presentation prompts" and "Show prompts when measuring standards." The white box for Sample presentation prompt (Before reading 1) will be activated. Type "Place sample at port" into this box.



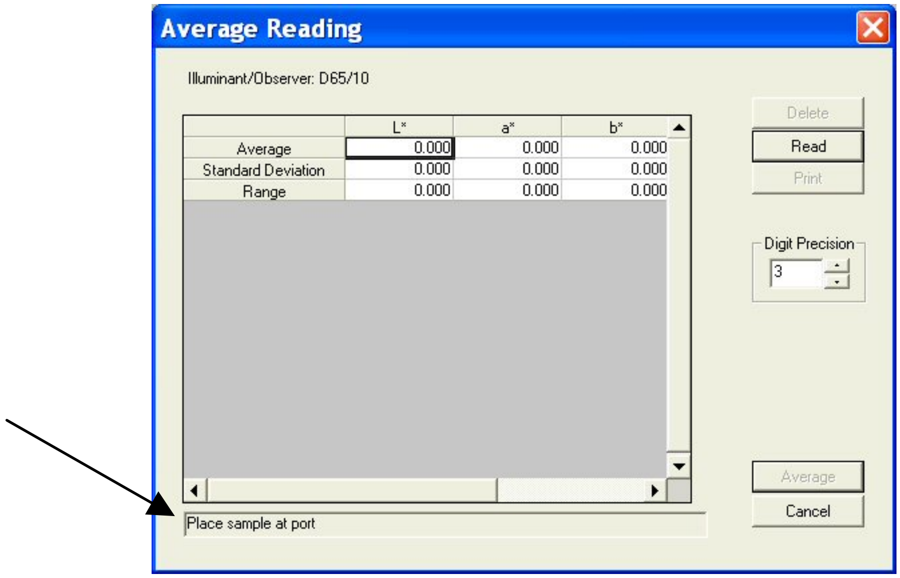
7. Click the right arrow (>>) button. The text above the box will change to "Sample presentation prompt (Before reading 2)." Type "Rotate sample 90 degrees" into this box.



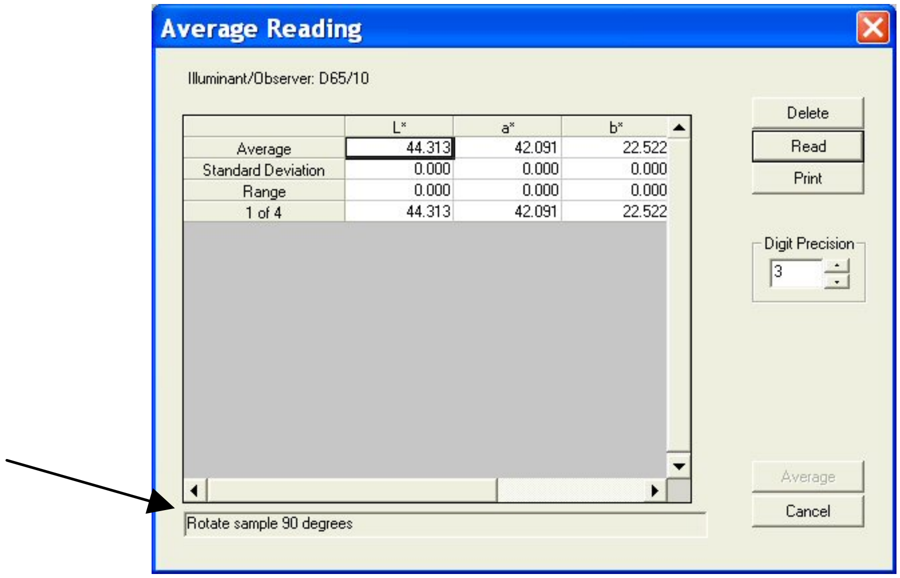
8. Click the right arrow button to move to the prompt boxes for readings 3 and 4. Enter “Rotate sample 90 degrees” for these prompts, as well.

9. Click **OK** to close the Average Method screen.

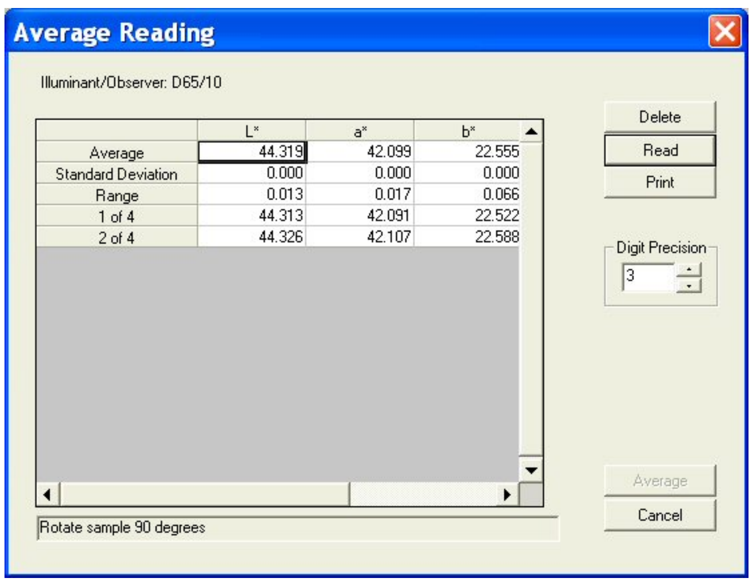
10. Initiate the reading of a standard. The Average Reading screen appears as follows. Note the prompt to place the sample at the port shown at the bottom of the screen.



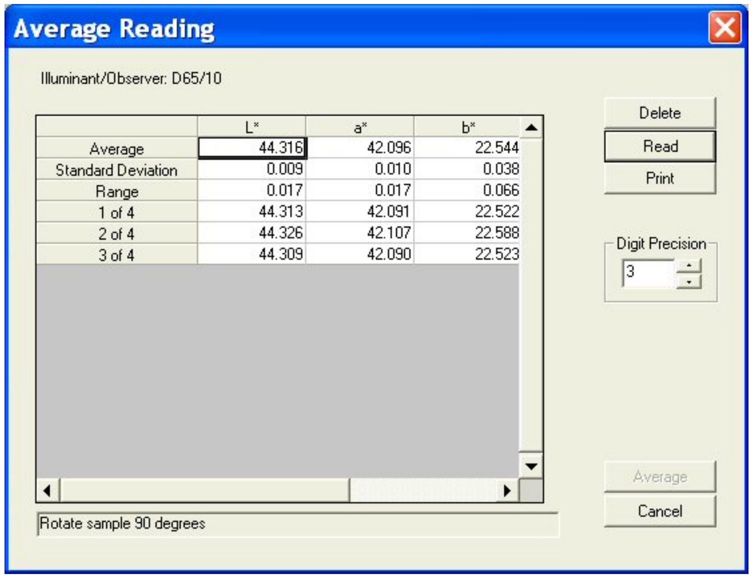
11. Place the sample at the measurement port and click **Read**. The standard is read and the values for the reading are placed in the Average Reading spreadsheet. Note the prompt to rotate the sample 90 degrees shown at the bottom of the screen.



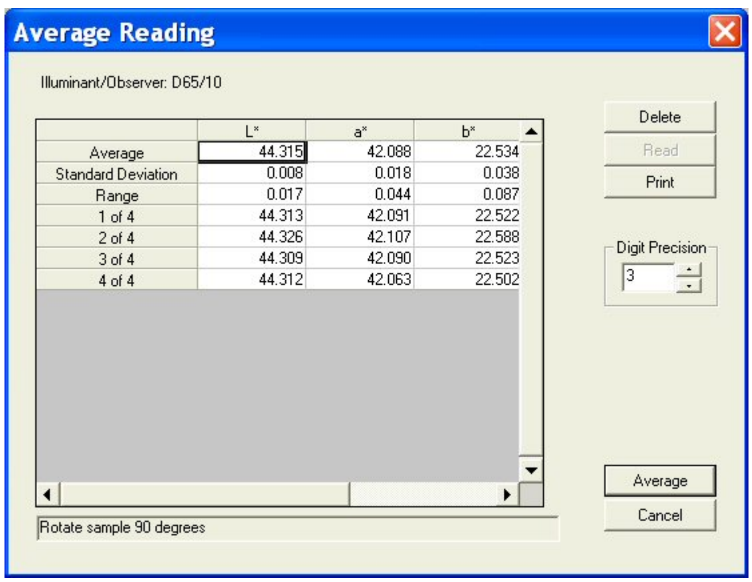
12. Rotate the sample 90 degrees and replace it at the port. Click **Read**. The standard is read again and its values placed in the Average Reading spreadsheet.



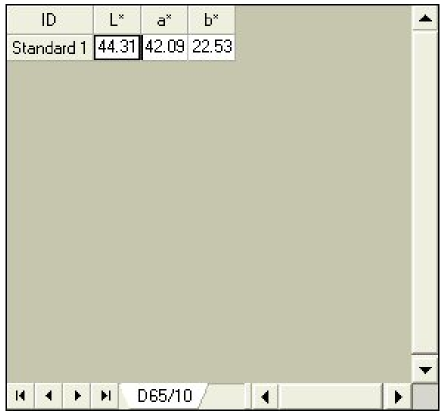
13. Per the prompt, rotate the sample 90 degrees again and replace it at the port. Click **Read**. The standard is read for the third time and its values placed in the Average Reading spreadsheet.



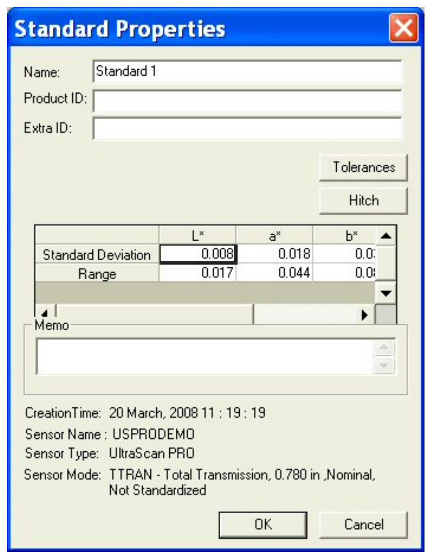
14. Per the prompt, rotate the sample 90 degrees again and replace it at the port. Click **Read**. The standard is read for the fourth time and its values placed in the Average Reading spreadsheet.



15. Click the **Average** button. The Average Reading screen closes and the averaged reading is placed into the job as a single standard measurement.



16. Right-click the averaged standard in the Job Tree and select **Properties**. The Standard Properties screen appears.



17. Note that the standard deviation and range for the 4 readings made and averaged are still available.

When you initialize a sample reading, the same sequence of events is observed.

Part II. Software Menu Commands

CHAPTER THREE

The File Menu

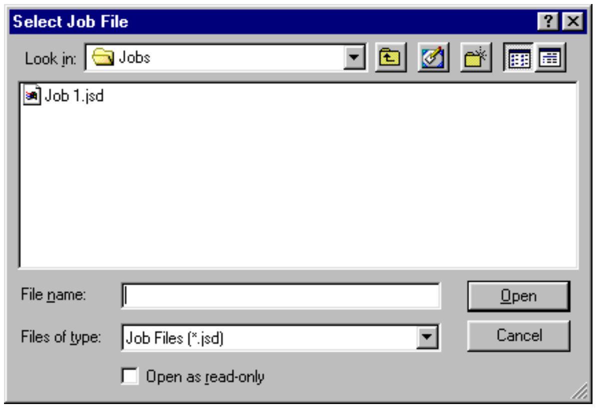
From the **File** menu you can open, save, and close jobs, as well as access the database, control the printer, e-mail jobs, and exit EasyMatch QC. The functions available through the **File** menu are described in the remainder of this chapter.

File/New Job

The **New Job** command in the **File** menu opens a new job based on the default template. This new job is presented on a new, untitled tab. The keyboard shortcut for this command is **Ctrl** + **N**.

File/Open Job

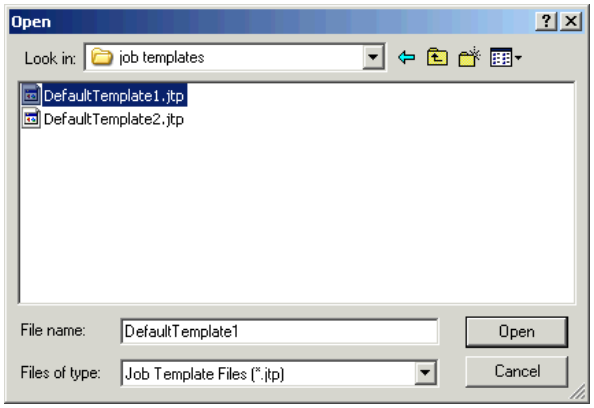
The **Open Job** command in the **File** menu allows you to open a pre-existing job that has been saved to your computer. The keyboard shortcut for this command is **Ctrl** + **O**.



When the Select Job File dialog box appears, locate the job you wish to open from any drive or folder accessible by your computer. Highlight the job name and then click **Open**. The job is opened into EasyMatch QC.

File/Open Job Template

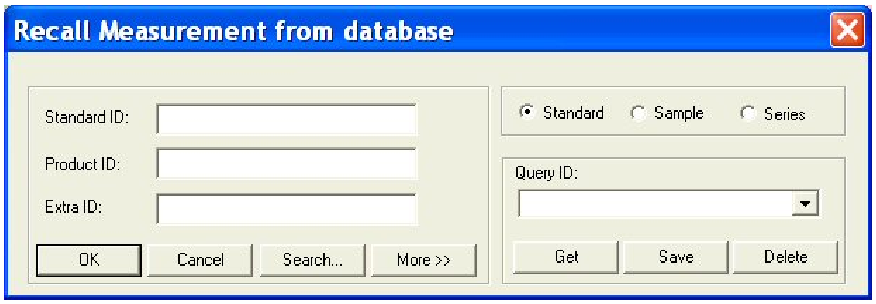
The **Open Job Template** command in the **File** menu allows you to select a template to open and modify or use as the basis of a new job.



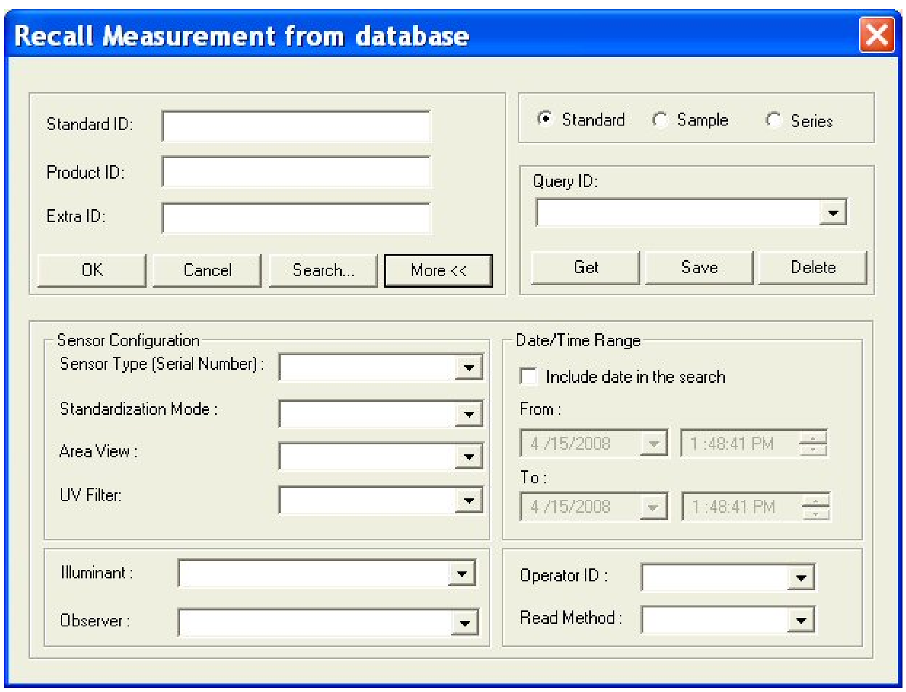
When the Open dialog box appears, locate the template you wish to open from any drive or folder accessible by your computer. Highlight the template name and then click **Open**. The template is opened into EasyMatch QC.

File/Recall Measurement From Database

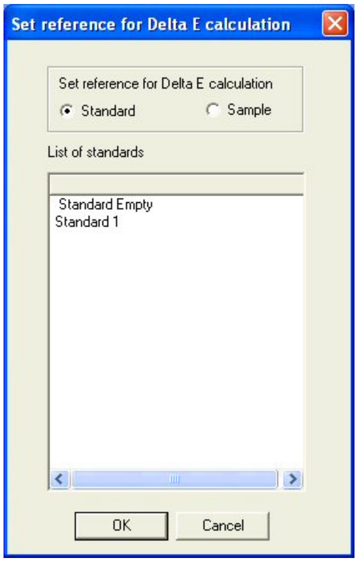
When you choose **Recall Measurement From Database** from the **File** menu, a window appears where you must first choose whether you wish to recall a standard, sample, or series by choosing the appropriate radio button at the top right of the screen. On the left, you can enter the ID, Product ID, and/or Extra ID for the measurement(s) to be recalled. You can also use * and ? wildcards to recall measurements. For example, to recall all measurements that start with “T” you would enter “T*” for the ID.



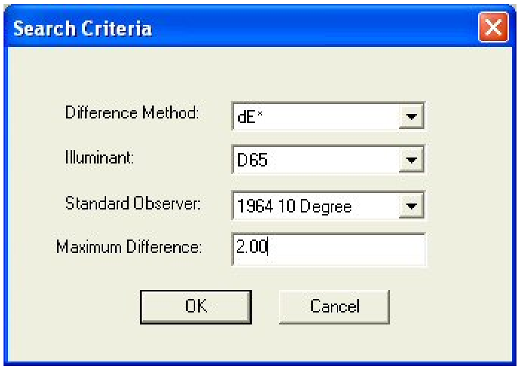
Click **More** if you wish to add information concerning the sensor, date and time, or other data parameters to your query.



Click **Search** if you wish to recall items based on their color difference from a particular standard or sample that is contained in the current job. The following screen appears.



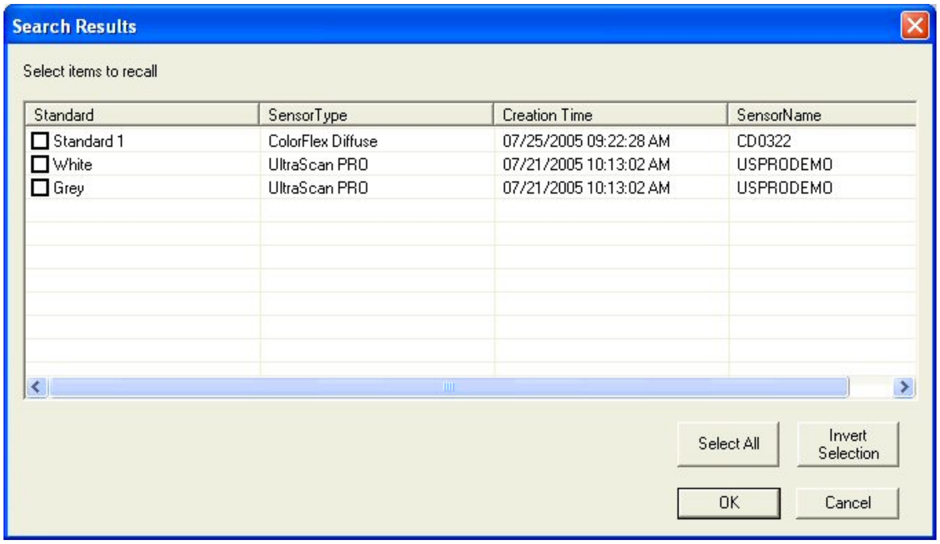
Choose whether you wish to search based on differences from a standard or sample and then highlight the standard or sample for comparison in the white box. Then click **OK**. The Search Criteria screen appears.



Select the color difference parameter, illuminant, and observer you wish to use for the comparison and then enter the maximum color difference value from the selected sample or standard you wish to see. In the example shown above, all standards within 2.00 dE units using D65/10° from Sample 1 will be recalled. Click **OK**.

You can save a set of search parameters as a query available for future use by typing in a Query ID and clicking **Save**. Later, select the Query ID from the drop-down box and click **Get** to recall the query.

After you have entered your selection parameters or recalled a query, click **OK** to display a list of the items in the database that match your recall parameters. You may sort this list, if you like, by clicking on the column header for the parameter by which you want to sort.

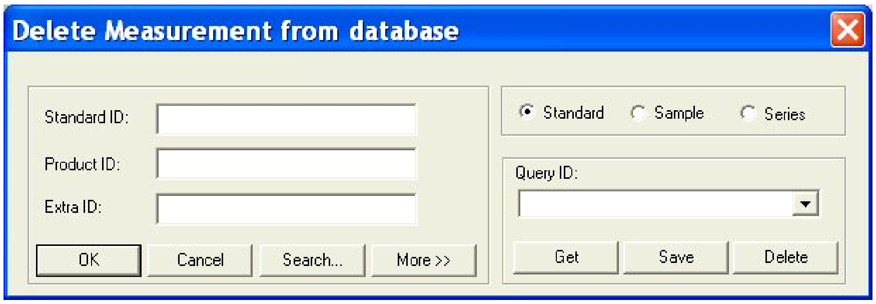


Select (check) the items you wish to recall into the current job and click **OK**. They will be recalled and placed in the job.

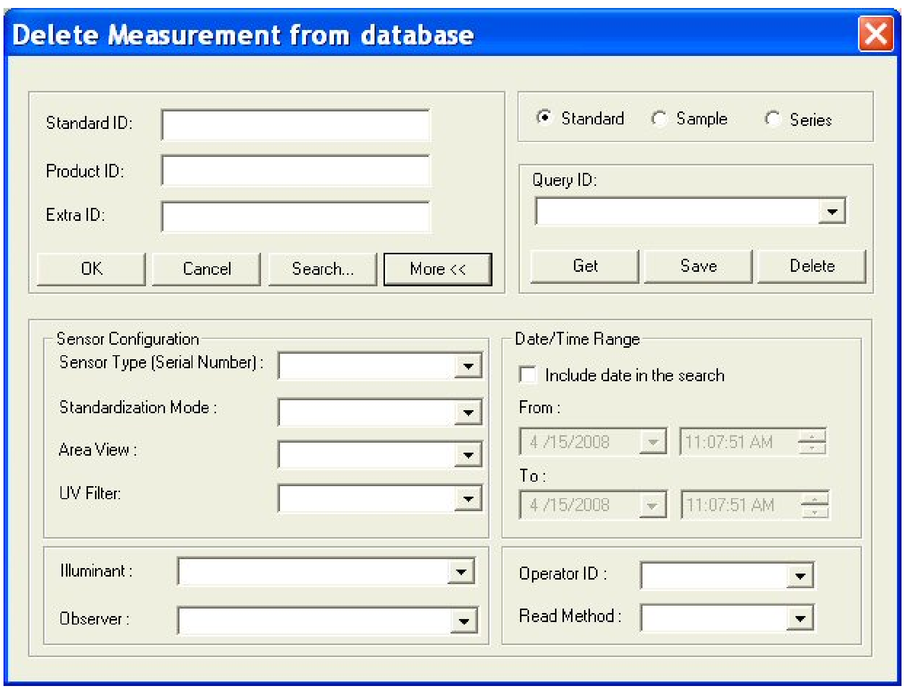
The keyboard shortcut for the **Recall Measurement From Database** command is **Ctrl** + **R**. More instructions on recalling measurements are provided in Lesson 6 in Chapter 2.

File/Delete Measurement From Database

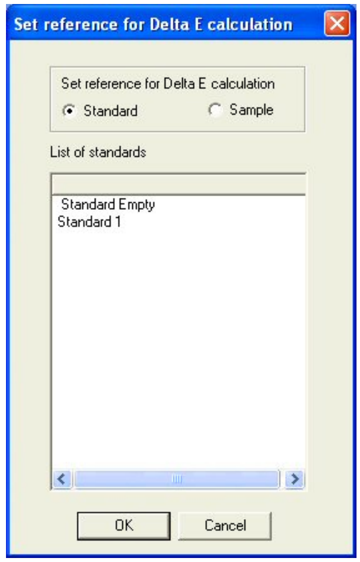
When you choose **Delete Measurement From Database** from the **File** menu, a window appears where you must first choose whether you wish to delete a standard, sample, or series by choosing the appropriate radio button at the top right of the screen. On the left, you can enter the ID, Product ID, and/or Extra ID for the measurement(s) to be deleted. You can also use * and ? wildcards to recall measurements. For example, to delete all measurements that start with "T" you would enter "T*" for the ID.



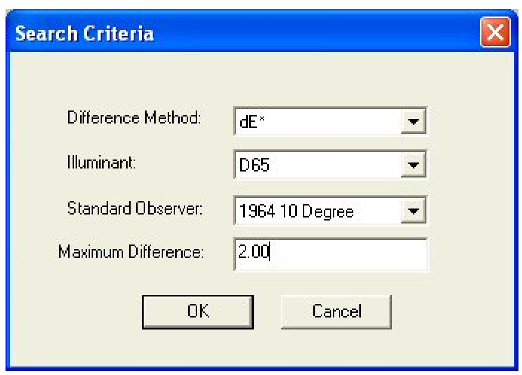
Click **More** if you wish to add information concerning the sensor, date and time, or other data parameters to your query.



Click **Search** if you wish to delete items based on their color difference from a particular standard or sample that is contained in the current job. The following screen appears.



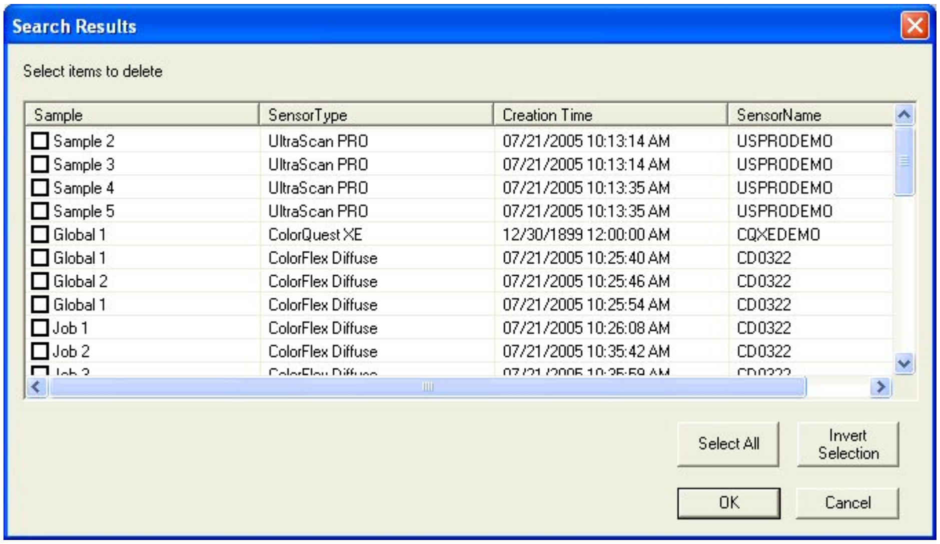
Choose whether you wish to search based on differences from a standard or sample and then highlight the standard or sample for comparison in the white box. Then click **OK**. The Search Criteria screen appears.



Select the color difference parameter, illuminant, and observer you wish to use for the comparison and then enter the maximum color difference value from the selected sample or standard you wish to see. In the example shown above, all standards within 2.00 dE units using D65/10° from Sample 1 will be deleted. Click **OK**.

You can save a set of search parameters as a query available for future use by typing in a Query ID and clicking **Save**. Later, select the Query ID from the drop-down box and click **Get** to recall the query.

After you have entered your selection parameters or recalled a query, click **OK** to display a list of the items in the database that match your delete parameters. You may sort this list, if you like, by clicking on the column header for the parameter by which you want to sort.



Select (check) the items you wish to delete from the database and click **OK**. They will be deleted from the database.

More instructions on deleting measurements are provided in Lesson 6 in Chapter 2.

File/Close Job

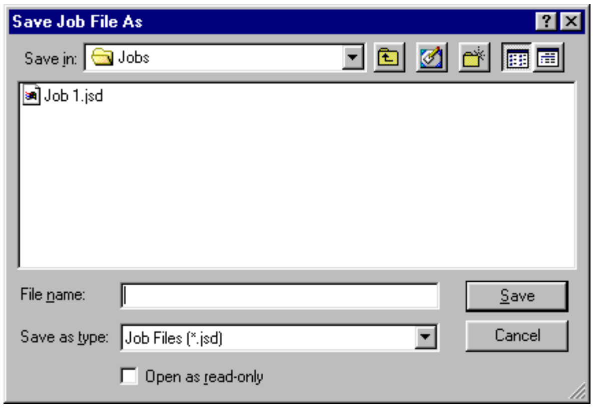
The **Close Job** command in the **File** menu saves the current job using its pre-established name and then closes the job. If the job is untitled, it prompts for a job name and then saves the job using its new name before closing the job.

File/Save Job

The **Save Job** command in the **File** menu saves the current job, including its measurements and screen configuration. If the job has been saved previously, it will automatically be saved under the same name. Otherwise, you will be prompted to enter a name. The keyboard shortcut for this command is **Ctrl** + **S**.

File/Save Job As

The **Save Job As** command in the **File** menu allows you to save the current job under a new name or to name a previously untitled job. The complete job, including its measurements and screen configuration, is saved. The keyboard shortcut for this command is **Ctrl** + **A**.



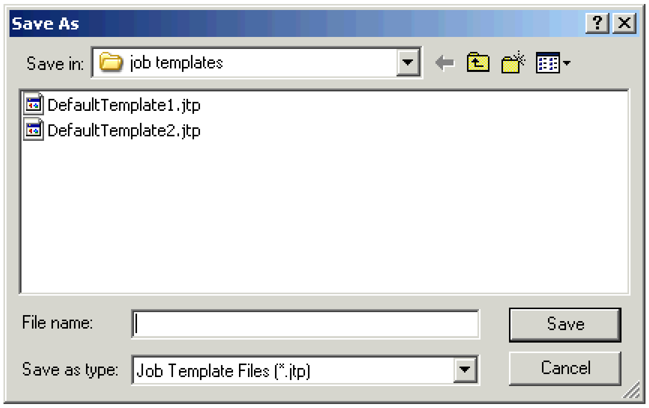
When the Save Job File As dialog box appears, locate the drive and folder where you wish to save the job (any that are accessible by your computer). Type the desired job name into the File name box and then click **Save**. (Long file names and spaces are acceptable.) The job is saved.

File/Save Job Template

The **Save Job Template** command in the **File** menu saves the screen configuration of the current job as a template. If the template has been saved previously, it will automatically be saved under the same name. Otherwise, you will be prompted to enter a name. The keyboard shortcut for this command is **Ctrl** + **J**.

File/Save Job Template As

The **Save Job Template As** command in the **File** menu allows you to save the job template currently in use under a new name.



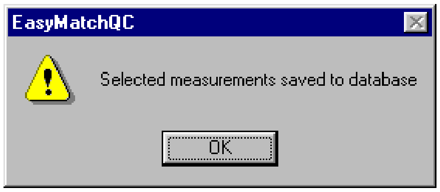
When the Save As dialog box appears, locate the drive and folder where you wish to save the template (any that are accessible by your computer). Type the desired template name into the File name box and then click **Save**. (Long file names and spaces are acceptable.) The template is saved using the new name.

File/Apply Template to Job

The **Apply Template to Job** command in the **File** menu allows you to apply a template to an existing job and have the configuration of that job change accordingly. The keyboard shortcut for this command is **Ctrl** + **T**.

File/Save Measurement to Database

The **Save Measurement to Database** command in the **File** menu saves any standards and samples currently selected (highlighted) in the Job Tree to the database. Once the measurement(s) are saved, the following message is shown. The keyboard shortcut for this command is **Ctrl** + **M**.



File/eSignature (-ER Version Only)

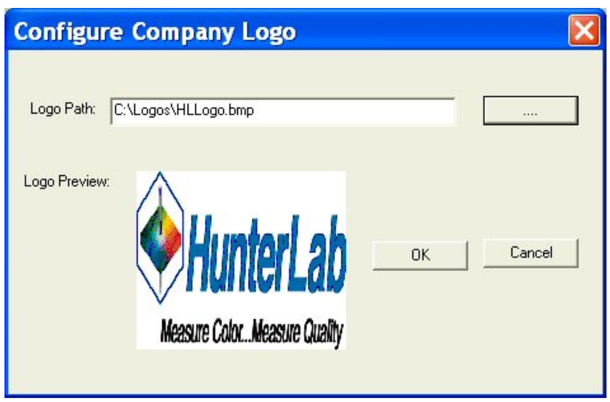
The **eSignature** command in the **File** menu allows you to apply an electronic signature to the job. The following screen appears:

Enter your EasyMatch QC user name and password, and type in the meaning of the signature or choose the meaning of the signature (creation, review, approval, etc.) from the drop-down box in the Comments box. These choices were configured by your System Administrator using the CFR Facile Admin tool (see the Validation and Compliance Notebook for more information). Click **Sign**. After a moment, the signature is permanently applied to the job and can be viewed and printed by selecting **Audit Log** from the **View** menu.

File/Configure Company Logo

The **Configure Company Logo** command in the **File** menu allows you add a bitmap (.BMP) company logo or other graphic to printouts created using the **Print Job Setup** command, also in the **File** menu. The following screen appears:

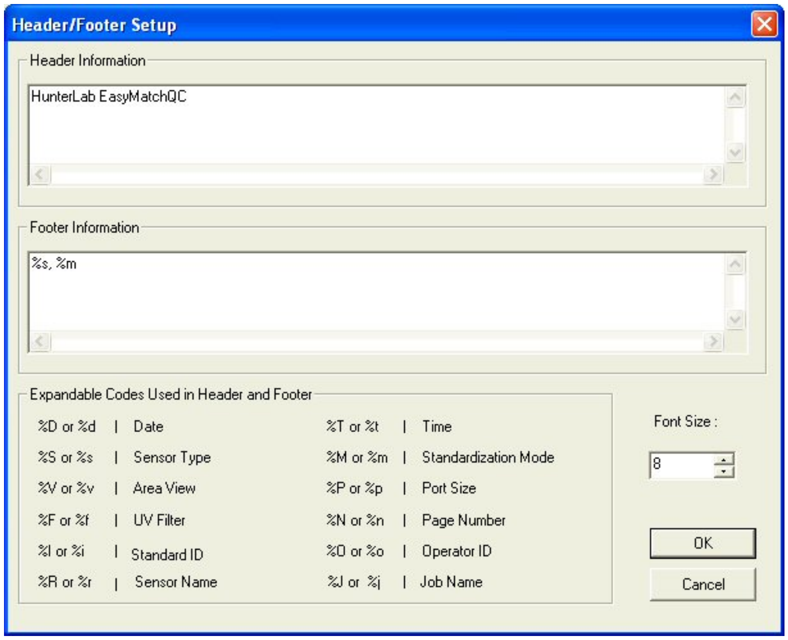
Click the Browse (**...**) button to find the file name and location for the logo file. The file can then be previewed on the Configure Company Logo screen.



Click **OK**. This logo will now be available as an item available for printing in print jobs.

File/Header//Footer Setup

The **Header/Footer Setup** command in the **File** menu allows you to configure the headers and footers that will be applied to all of your printouts in this job.

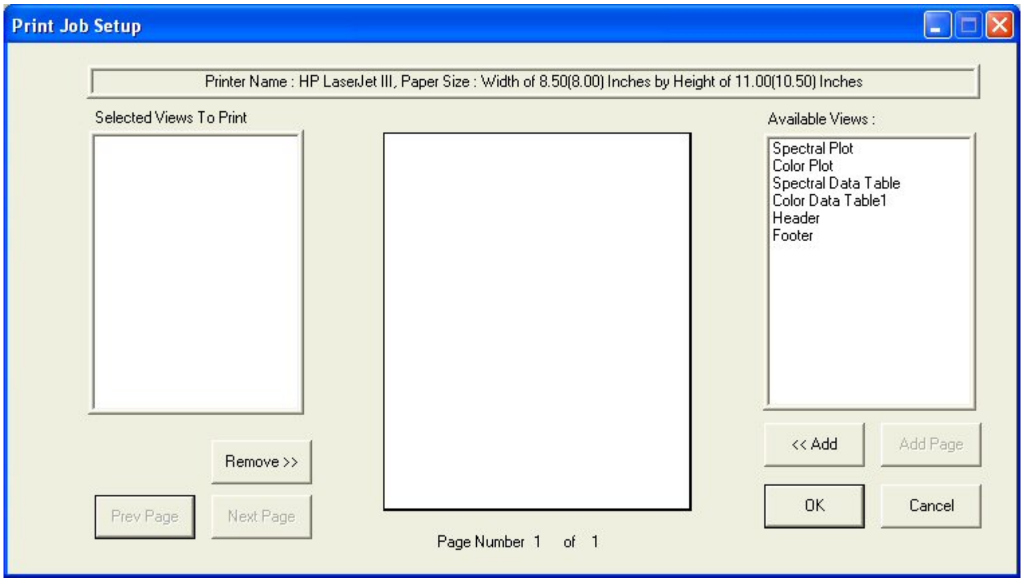


You may type any information into the Header Information and Footer Information boxes that you wish to have displayed on every page of your printouts. Type any of the codes listed at the bottom of the screen in order to have that information automatically inserted. For example, type "%t" to have the time of printing shown on the printout.

File/Print Job Setup

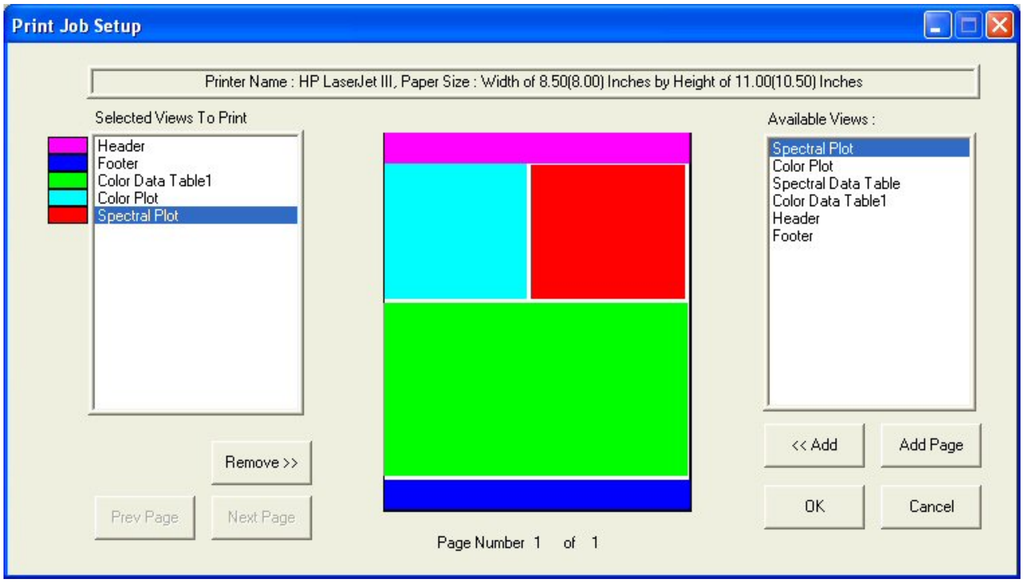
The **Print Job Setup** command in the **File** menu allows you to lay out a report that will be printed when you select **Print Job** from the **File** menu or click the **Print** button on the default toolbar. All of the data views currently in your job except the Job Tree may be printed as part of your report. When you print the report, data for all the samples and standards currently selected in your Job Tree for display in the other views will be printed.

When **Print Job Setup** is selected, the Print Job Setup screen is obtained. The printer and paper size as designated for your Windows default printer will be shown at the top of the screen and all of the data views in the current job are shown under Available Items. The header and footer configured in **Header/Footer Setup** and company logo configured in **Configure Company Logo** (discussed earlier in this chapter) may also be placed in the report.



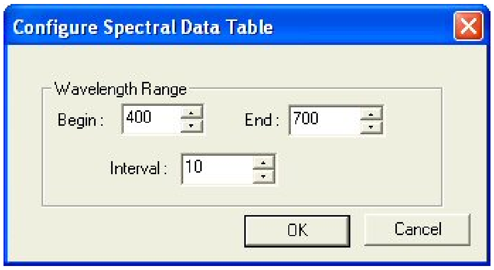
To add an item to your report, highlight it in the Available Items list on the right side of the display by clicking on its name and then click the **<<Add** button. The item is moved to the Selected Items box and is assigned a representative color. You may remove an item added in error by highlighting it in the Selected Items list and using the **Remove>>** button.

To configure the size and location of an item on the page, highlight it in the Selected Items list on the left side of the screen. Then click the mouse on the page representation in the middle of the screen where you wish to locate one of the corners of the view. Hold the mouse button and drag to the location of the opposite corner. Then release the mouse button. The colored box indicates the location and size of that data view. It may be altered at any time using the same procedure.



You may click the **Add Page** button to add a new page to your report and scroll through the pages of your report using the **Prev Page** and **Next Page** buttons.

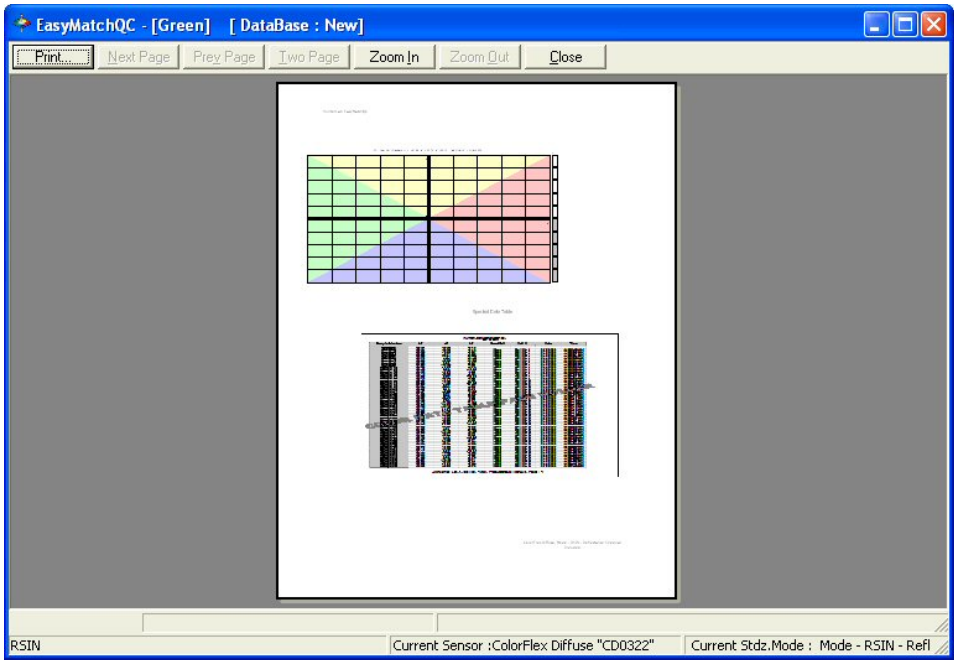
When a Spectral Data Table has been added to the Selected Items box and is highlighted, a **Configure** button appears next to the **Remove>>** button. When the **Configure** button is clicked, the Configure Spectral Data screen appears on which you can alter the wavelength range and interval that will be shown in this part of the screen. You may include multiple Spectral Data Tables with different wavelength ranges if you wish in order to fit all of the data in the print job.



Detailed instructions for configuring and using the Print Job Setup feature are provided in Lesson 9 of Chapter 2.

File/Print Job Preview

The **Print Job Preview** command in the **File** menu allows you to view your configured print job on-screen as it will appear when printed. If you select this command without having configured the print out using the **Print Job Setup** command, you will be prompted to do so.

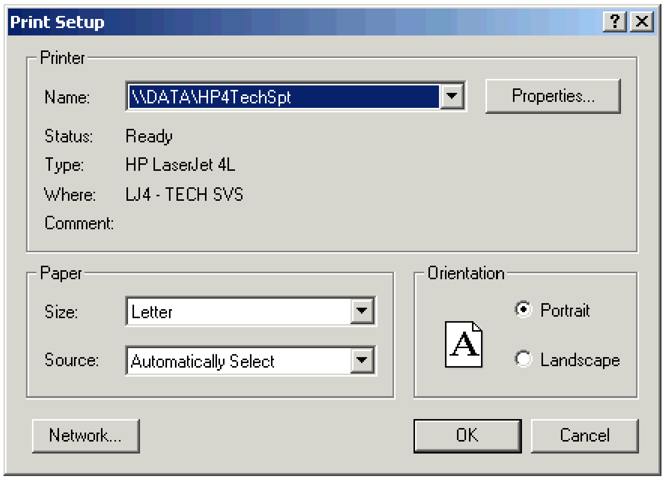


File/Print Job

The **Print Job** command in the **File** menu initiates printing of the print job that was configured using the **Print Out Setup** command. The job is printed to the Windows default printer. The keyboard shortcut for this command is **Ctrl** + **P**. If you select this command without having configured the print out using the **Print Out Setup** command, you will be prompted to do so.

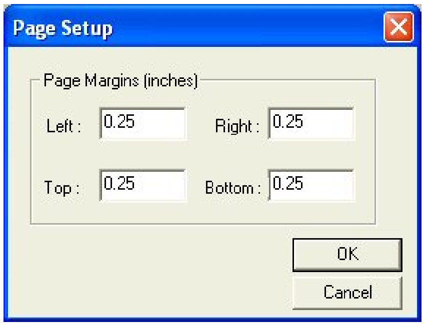
File/Printer Setup

The **Printer Setup** command in the **File** menu causes the Windows Print Setup dialog box to be displayed so you can configure your printer parameters without printing anything. Click **OK** when your configuration is complete. The configuration indicated here is used for all printing in EasyMatch QC, regardless of job.



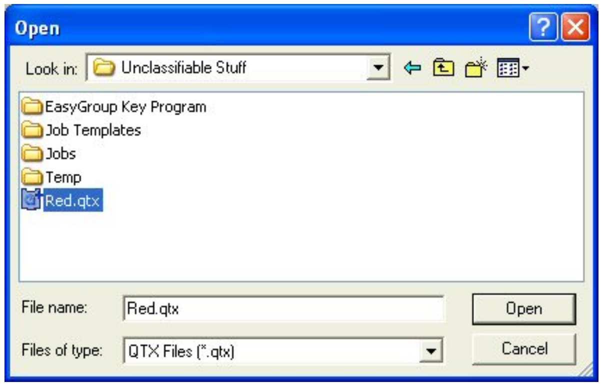
File/Page Setup

The **Page Setup** command in the **File** menu opens the Page Setup window in which you can set the margins you wish to leave on each page when printing the print job configured using the **Print Job Setup** command described earlier in this chapter. Click **OK** when your configuration is complete.



File/Import QTX Format

The **Import QTX Format** command in the **File** menu opens the Windows Open box that allows you to choose an existing QTX file for import into the current EasyMatch QC job. Once you click **Open**, the data records in the QTX file will be added to the current job.



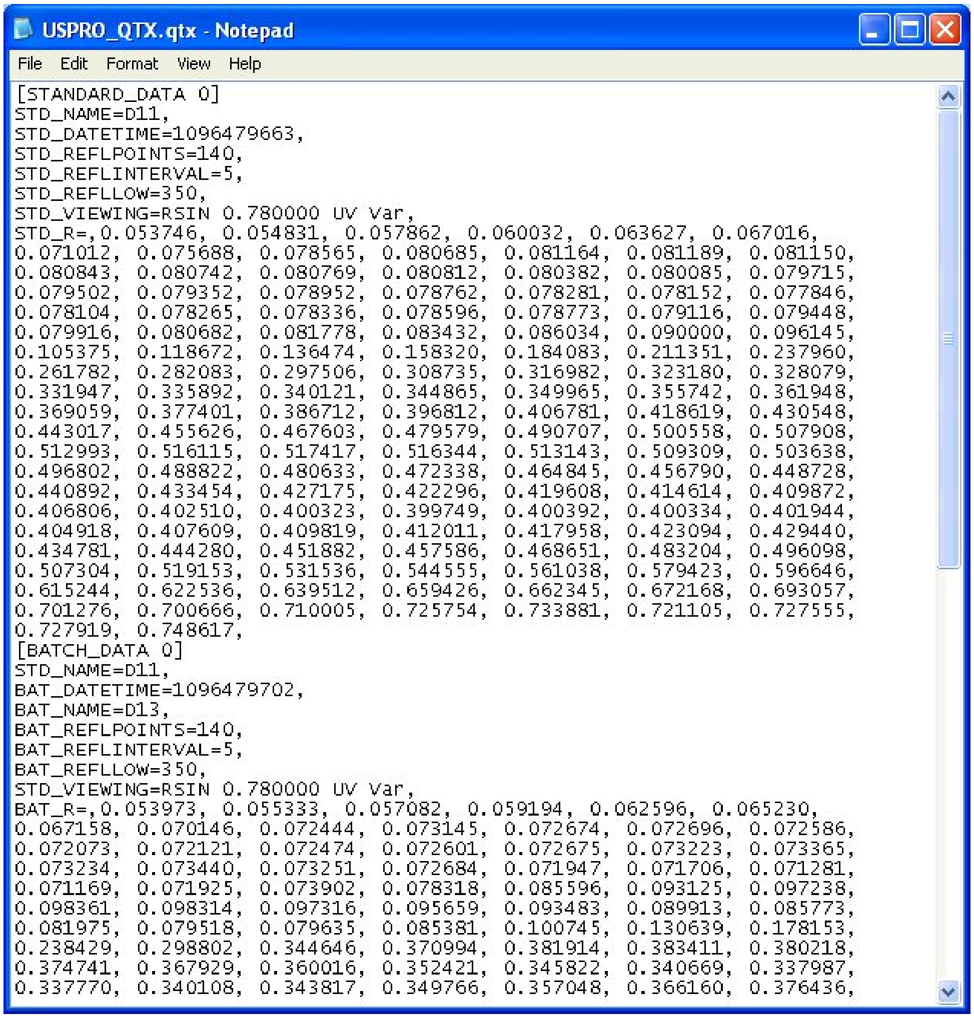
Note: A sensor of the same type (i.e., ColorQuest XE or UltraScan PRO) as the one used in making the measurements contained in the QTX file must be the current active sensor in EasyMatch QC in order for the QTX file to import.

File/Export

The **Export** command in the **File** menu allows you to export job data to either the QTX format or SLI-Taper format. A submenu appears from which you can make this selection.

QTX Format

Select **QTX Format** to export the data in the job to a QTX color communication file that, when opened in Windows Notepad, resembles the following:

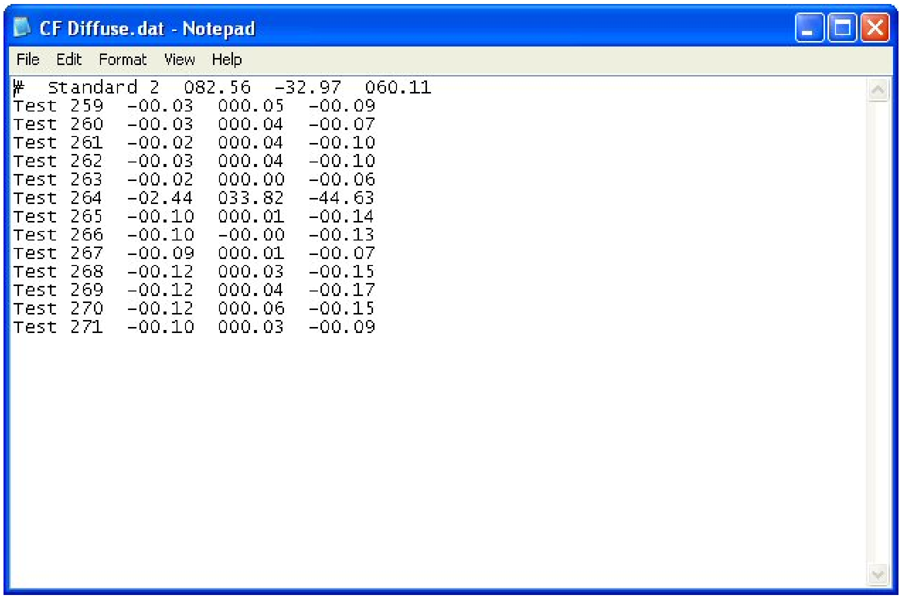

USPRO_QTX.qtx - Notepad

File Edit Format View Help

```
[STANDARD_DATA 0]
STD_NAME=D11,
STD_DATETIME=1096479663,
STD_REFLPOINTS=140,
STD_REFLINTERVAL=5,
STD_REFLLOW=350,
STD_VIEWING=RSIN 0.780000 UV Var,
STD_R=,0.053746, 0.054831, 0.057862, 0.060032, 0.063627, 0.067016,
0.071012, 0.075688, 0.078565, 0.080685, 0.081164, 0.081189, 0.081150,
0.080843, 0.080742, 0.080769, 0.080812, 0.080382, 0.080085, 0.079715,
0.079502, 0.079352, 0.078952, 0.078762, 0.078281, 0.078152, 0.077846,
0.078104, 0.078265, 0.078336, 0.078596, 0.078773, 0.079116, 0.079448,
0.079916, 0.080682, 0.081778, 0.083432, 0.086034, 0.090000, 0.096145,
0.105375, 0.118672, 0.136474, 0.158320, 0.184083, 0.211351, 0.237960,
0.261782, 0.282083, 0.297506, 0.308735, 0.316982, 0.323180, 0.328079,
0.331947, 0.335892, 0.340121, 0.344865, 0.349965, 0.355742, 0.361948,
0.369059, 0.377401, 0.386712, 0.396812, 0.406781, 0.418619, 0.430548,
0.443017, 0.455626, 0.467603, 0.479579, 0.490707, 0.500558, 0.507908,
0.512993, 0.516115, 0.517417, 0.516344, 0.513143, 0.509309, 0.503638,
0.496802, 0.488822, 0.480633, 0.472338, 0.464845, 0.456790, 0.448728,
0.440892, 0.433454, 0.427175, 0.422296, 0.419608, 0.414614, 0.409872,
0.406806, 0.402510, 0.400323, 0.399749, 0.400392, 0.400334, 0.401944,
0.404918, 0.407609, 0.409819, 0.412011, 0.417958, 0.423094, 0.429440,
0.434781, 0.444280, 0.451882, 0.457586, 0.468651, 0.483204, 0.496098,
0.507304, 0.519153, 0.531536, 0.544555, 0.561038, 0.579423, 0.596646,
0.615244, 0.622536, 0.639512, 0.659426, 0.662345, 0.672168, 0.693057,
0.701276, 0.700666, 0.710005, 0.725754, 0.733881, 0.721105, 0.727555,
0.727919, 0.748617,
[BATCH_DATA 0]
STD_NAME=D11,
BAT_DATETIME=1096479702,
BAT_NAME=D13,
BAT_REFLPOINTS=140,
BAT_REFLINTERVAL=5,
BAT_REFLLOW=350,
STD_VIEWING=RSIN 0.780000 UV Var,
BAT_R=,0.053973, 0.055333, 0.057082, 0.059194, 0.062596, 0.065230,
0.067158, 0.070146, 0.072444, 0.073145, 0.072674, 0.072696, 0.072586,
0.072073, 0.072121, 0.072474, 0.072601, 0.072675, 0.073223, 0.073365,
0.073234, 0.073440, 0.073251, 0.072684, 0.071947, 0.071706, 0.071281,
0.071169, 0.071925, 0.073902, 0.078318, 0.085596, 0.093125, 0.097238,
0.098361, 0.098314, 0.097316, 0.095659, 0.093483, 0.089913, 0.085773,
0.081975, 0.079518, 0.079635, 0.085381, 0.100745, 0.130639, 0.178153,
0.238429, 0.298802, 0.344646, 0.370994, 0.381914, 0.383411, 0.380218,
0.374741, 0.367929, 0.360016, 0.352421, 0.345822, 0.340669, 0.337987,
0.337770, 0.340108, 0.343817, 0.349766, 0.357048, 0.366160, 0.376436,
```

SLI-Taper

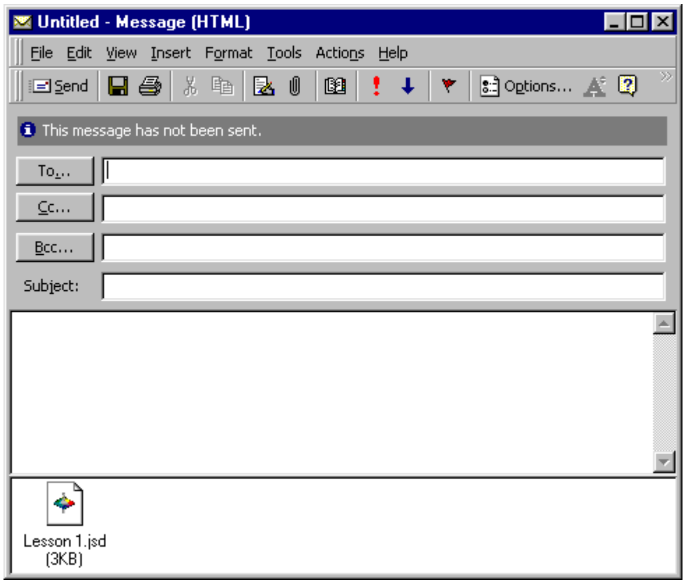
Select **SLI-Taper** to export the data in the job to a SLI-Taper data file that may then be used in SLI-Taper software. When opened in Windows Notepad, the file resembles the following:




```
#  Standard 2  082.56  -32.97  060.11
Test 259  -00.03  000.05  -00.09
Test 260  -00.03  000.04  -00.07
Test 261  -00.02  000.04  -00.10
Test 262  -00.03  000.04  -00.10
Test 263  -00.02  000.00  -00.06
Test 264  -02.44  033.82  -44.63
Test 265  -00.10  000.01  -00.14
Test 266  -00.10  -00.00  -00.13
Test 267  -00.09  000.01  -00.07
Test 268  -00.12  000.03  -00.15
Test 269  -00.12  000.04  -00.17
Test 270  -00.12  000.06  -00.15
Test 271  -00.10  000.03  -00.09
```

File/Email

The **Email** command in the **File** menu, and then the choice of **Job** or **Template** from the submenu that appears opens a new e-mail message and attaches the current job or template to that message. This command appears in the **File** menu only if an e-mail program is installed and available on your computer. The picture below uses Microsoft Outlook 98. Compose and send your e-mail as you normally would using your e-mail program.



*Note: If **Job** is chosen from the submenu, the job is e-mailed with its screen configuration (template) intact. If **Template** is chosen, only the template is e-mailed.*

File/Time Synchronization (-ER Version Only)

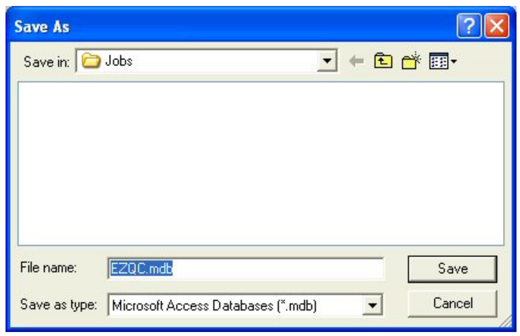
The **Time Synchronization** command in the **File** menu causes your client computer's clock to be synchronized with the server computer. Your system administrator should check the time and date on the server periodically to ensure that it is correct.

File/Database

The **Database** command in the **File** menu allows you to manually back up your Access database file, import data stored in a Universal Software or EasyMatch Textiles database into EasyMatch QC, or create a new Access database. A submenu appears containing these four choices.

Backup Database

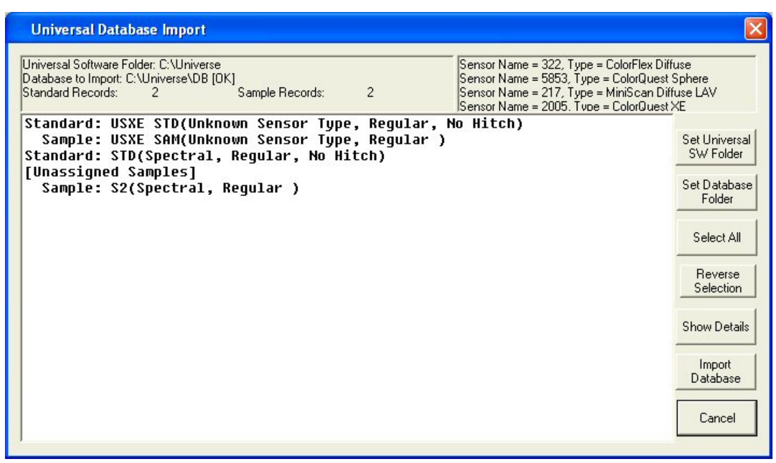
Select **Backup Database** to save a second copy of your EasyMatch QC Access database file to a location other than the one where it is currently stored. The following screen appears.



Browse for the location where you wish the backup copy of the database to be stored and then click **Save**. The file will be copied to this location.

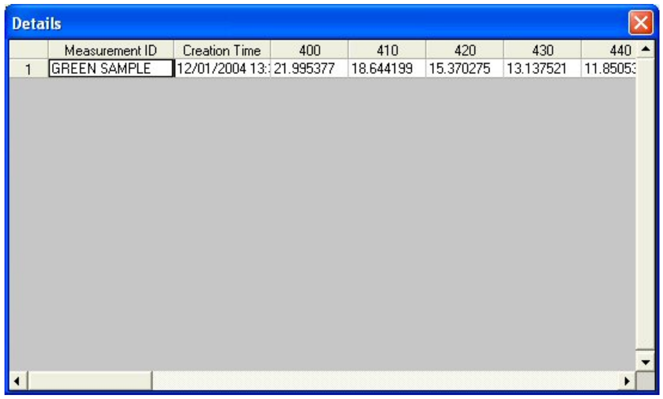
Universal Database Import

Select **Universal Database Import** to import measurements from a Universal Software database. Universal Software must be installed on this computer in order to complete the import, as the Universal installation provides necessary information to the import tool.

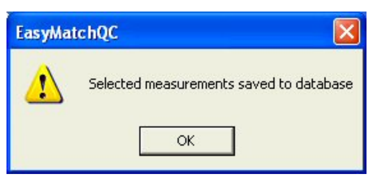


The import tool automatically looks for a database in the C:\Universe\DB folder on your hard drive. If this is the database you wish to import, you need not use the **Set Universal SW Folder** or **Set Database Folder** buttons. If, on the other hand, your Universal Software was installed into a folder other than C:\Universe, click the **Set Universal SW Folder** button and select the folder where Universal Software was installed. If the Universal database you wish to import is located in a folder other than C:\Universe\DB, click the **Set Database Folder** button and select the folder where the database is located. When both folders have been indicated correctly, the sensor(s) with which the database measurements were made will be shown in the upper right corner of the screen and a list of samples and standards stored in the database will be shown below.

To examine the details (date and time of reading, plus spectral data) of any sample or standard, highlight it and click the **Show Details** button.

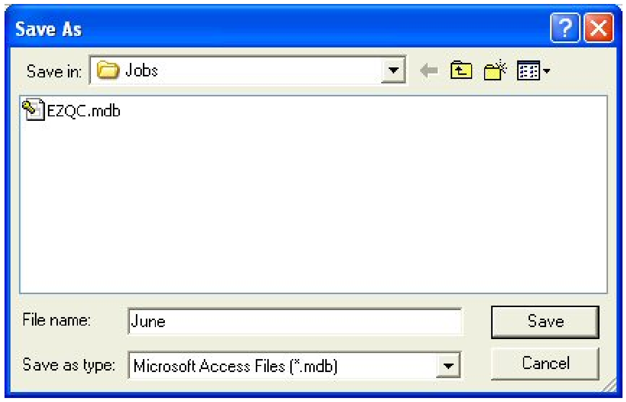


Select all the records you wish to import into EasyMatch QC using the **Ctrl** key plus clicking on each individual record, by holding the **Shift** key and clicking on the first and then the last record desired, or by clicking the **Select All** button. Then click **Import Database**. You will be given the choice to place the records in your EasyMatch QC database, in your current job, or in a new job. When you click **OK**, the records will be imported to the location you chose.



Create New Database

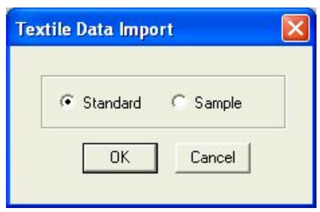
Select **Create New Database** to create a new, empty Access database with the name and location desired. This new database will not be used for storing measurements until you select it using **Options/System Configuration/Data Storage**.



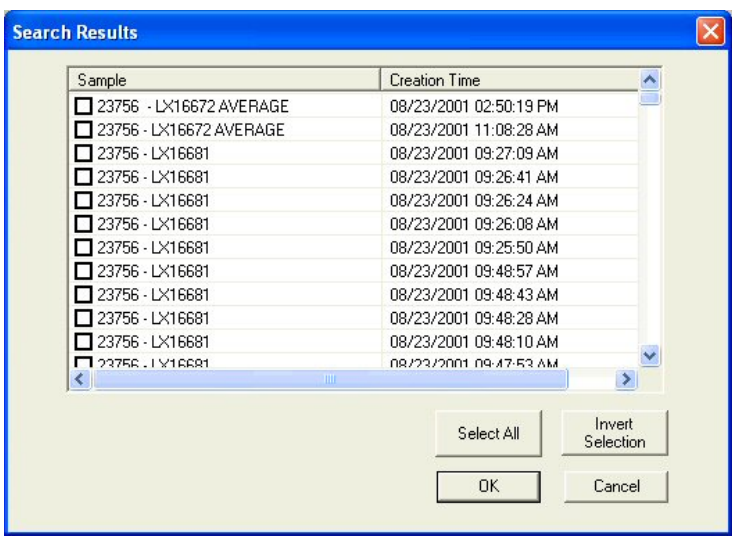
Import Textiles Database

Select **Import Textiles Database** to import measurements from an EasyMatch Textiles database. The following screen appears first.

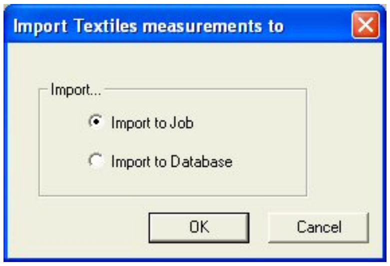
> *Note: Select Textiles Database must be checked with a Textiles Database Path set in **Options/System Configuration/Data Storage** before the **Import Textiles Database** command will be available in the **File** menu.*



Indicate whether you wish to import the standards that are in the database or the samples, then click **OK**.



The samples or standards available in the EasyMatch Textiles database are listed and you may select the ones you wish to import. Then click **OK**.

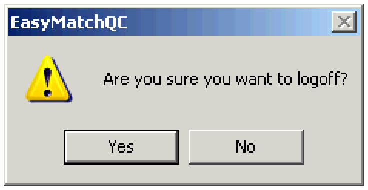


Indicate whether you wish to import the EasyMatch Textiles measurements into the current EasyMatch QC job or the EasyMatch QC database. Then click **OK**. The measurements will be imported as you instructed.

If you imported sample(s) to a job, you will be asked to link the sample(s) to a standard before they are inserted into the job.

File/Log Off

The **Log Off** command in the **File** menu logs the current user out of EasyMatch QC and returns to the EasyMatch QC splash screen so that the next user may log on. If the current job has not yet been saved, you will be prompted to save it before log off occurs.



*Note: This command is available only if Login Required is checked on the Startup Defaults tab available by choosing **Application Preferences** from the **Options** menu.*

File/Most Recently Opened Jobs

The most recently opened jobs area of the **File** menu lists the four most recently opened jobs. You may select the name of any of these jobs to open it quickly and easily.

File/Exit

The **Exit** command in the **File** menu allows you exit EasyMatch QC. If the current job has not yet been saved, you will be prompted to save it before exit occurs.

CHAPTER FOUR

The Edit Menu

From the **Edit** menu you can cut or copy the samples and standards highlighted in the Job Tree to the Windows clipboard for use in another job. Likewise, you can paste measurements from another job into this one. You may also delete measurements. The functions available through this menu are described in the remainder of this chapter.

Edit/Cut

The **Cut** command in the **Edit** menu allows the measurement(s) highlighted in the Job Tree to be removed and placed on the Windows clipboard. The measurements can then be pasted into another job. The keyboard shortcut for this command is **Ctrl** + **X**.

Note: If you cut measurement(s) and then don't paste them elsewhere, they will be permanently deleted.

Edit/Copy

The **Copy** command in the **Edit** menu allows the measurement(s) highlighted in the Job Tree to be copied to the Windows clipboard. The measurement(s) can then be pasted into another job. The keyboard shortcut for this command is **Ctrl** + **C**.

Items may also be dragged and dropped from one job to another in order to copy and then paste them.

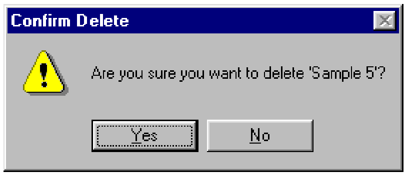
Edit/Paste

The **Paste** command in the **Edit** menu allows you to paste measurement(s) from one job into another. Before you select **Paste**, select the job in which you would like the measurement to be placed and click in the Job Tree (in a blank area if you cut or copied a standard or on the desired "Samples" branch header for a sample). Then, when you select **Paste**, the measurement(s) from the clipboard are placed in that job. The keyboard shortcut for this command is **Ctrl** + **V**.

Items may also be dragged and dropped from one job to another in order to copy and then paste them.

Edit/Delete

The **Delete** command in the **Edit** menu deletes the measurement(s) that are highlighted in the Job Tree from the current job. You are prompted to confirm that you actually wish to delete.



The keyboard shortcut for this command is **Del**.

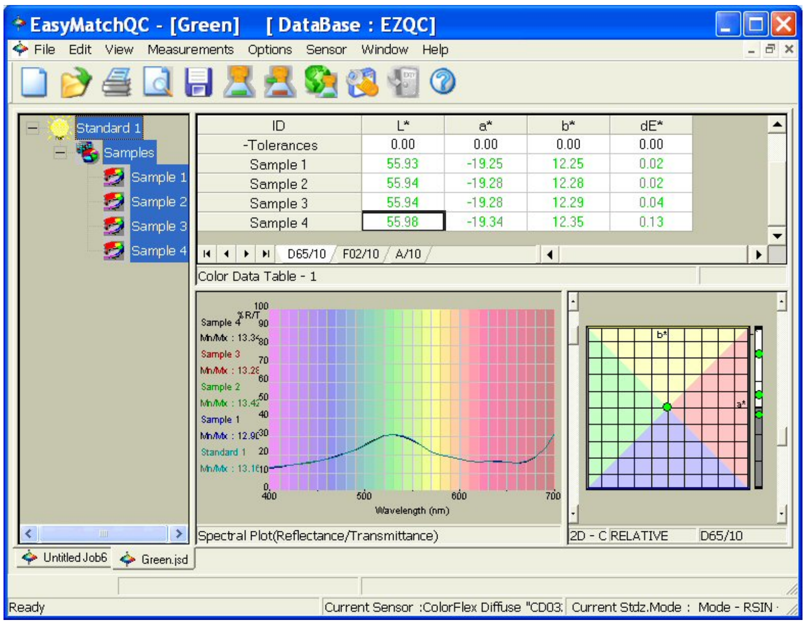
CHAPTER FIVE

The View Menu

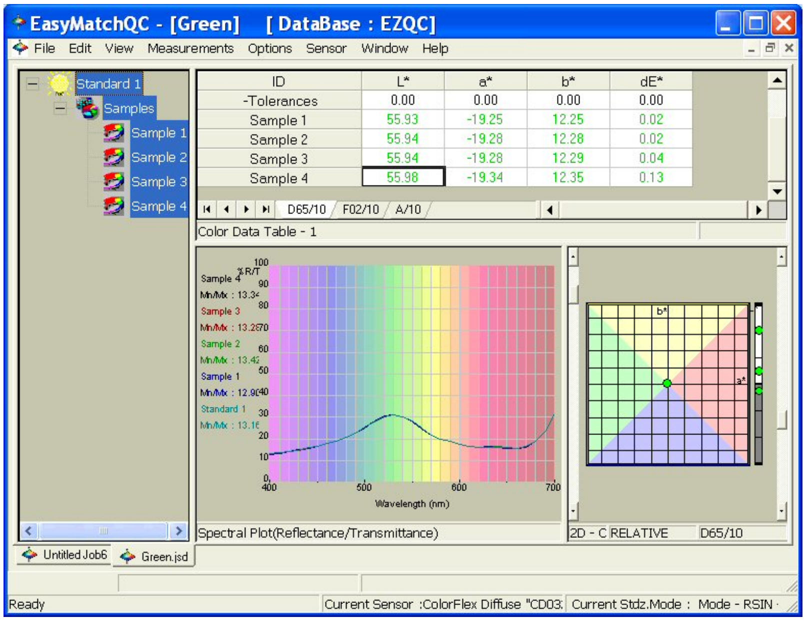
The **View** menu allows you to turn on or off display of the toolbar, status bar, and Job Tree on your EasyMatch QC screen. The functions available through this menu are described in the remainder of this chapter.

View/Toolbar

The **Toolbar** command in the **View** menu allows you to choose whether or not to display the toolbar beneath the menu bar at the top of your EasyMatch QC screen. When a check appears next to **Toolbar**, the toolbar is displayed. When no check appears, the toolbar is not displayed. The setting chosen here applies to this installation of EasyMatch QC as a whole, regardless what job is in use.



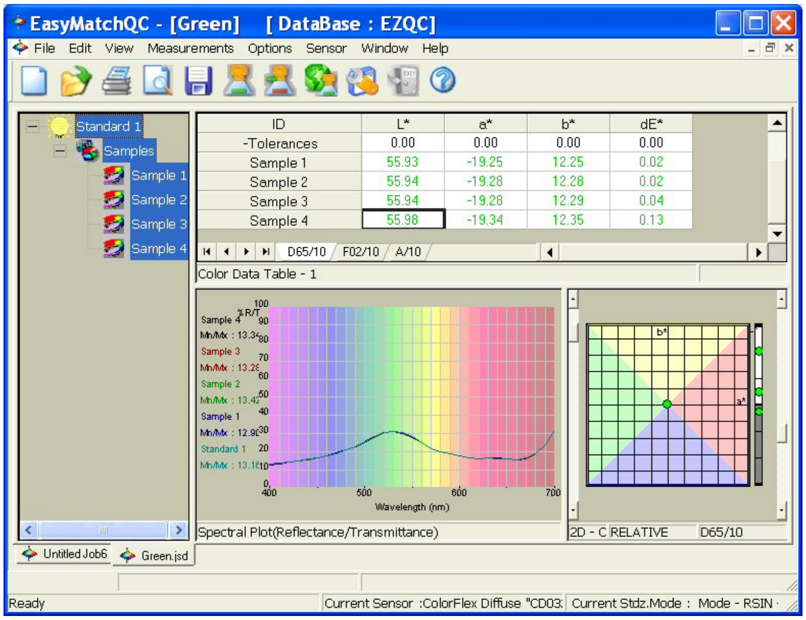
Toolbar is displayed.



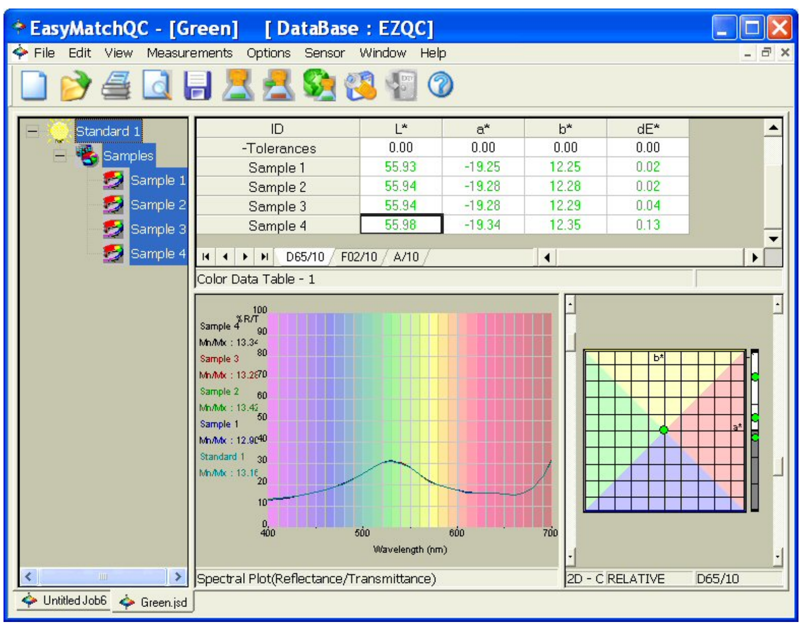
Toolbar is not displayed.

View/Status Bar

The **Status Bar** command in the **View** menu allows you to choose whether or not to display the status bar at the bottom of your EasyMatch QC screen. When a check appears next to **Status Bar**, the bar is displayed. When no check appears, the status bar is not displayed. The setting chosen here applies to this installation of EasyMatch QC as a whole, regardless what job is in use.



Status bar is displayed.

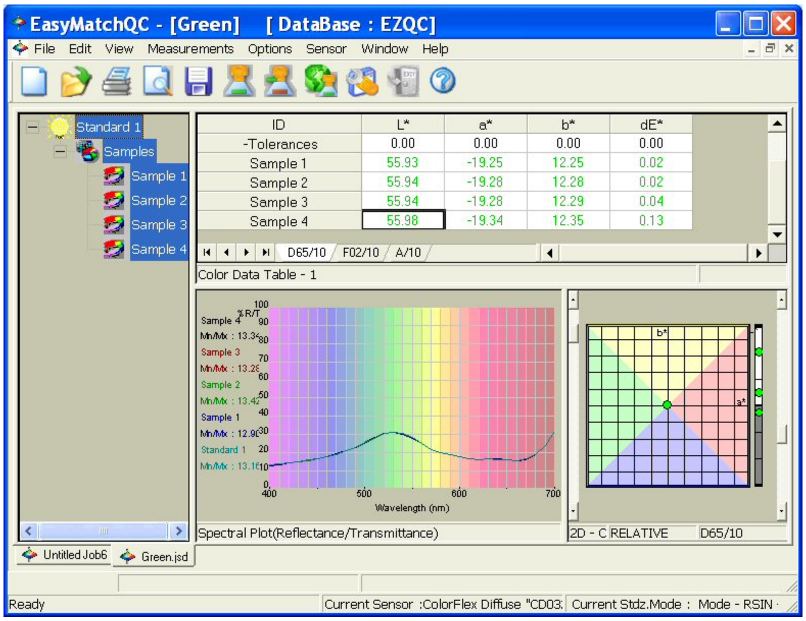


Status bar is not displayed.

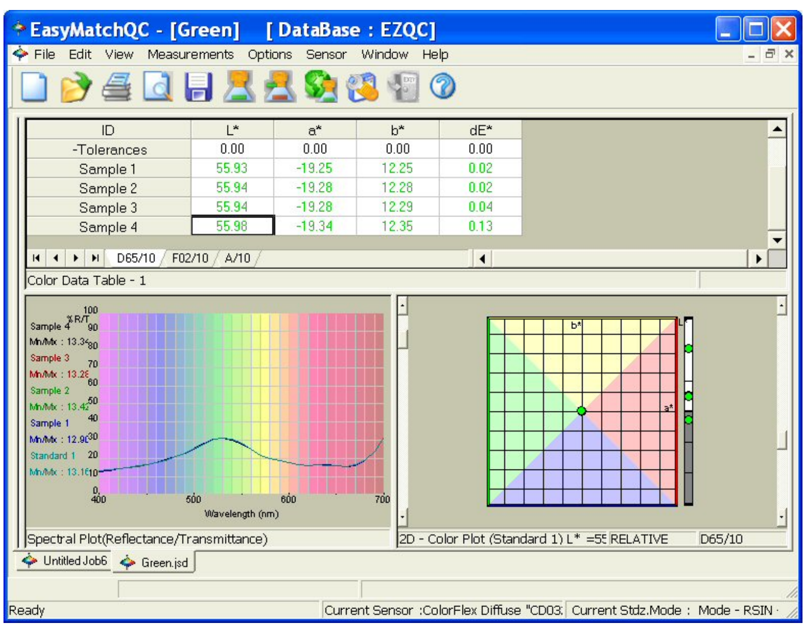
View/Job Tree

The **Job Tree** command in the **View** menu allows you to choose whether or not to display the Job Tree at the left of your EasyMatch QC screen for the current job. When a check appears next to **Job Tree**, the Job Tree is displayed. When no check appears, the Job Tree is not displayed.

Note: Some software functions require use of the Job Tree.



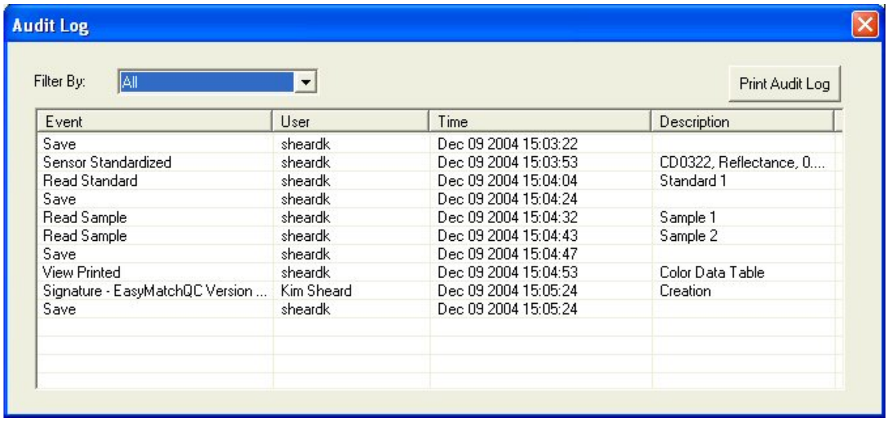
Job Tree is displayed.



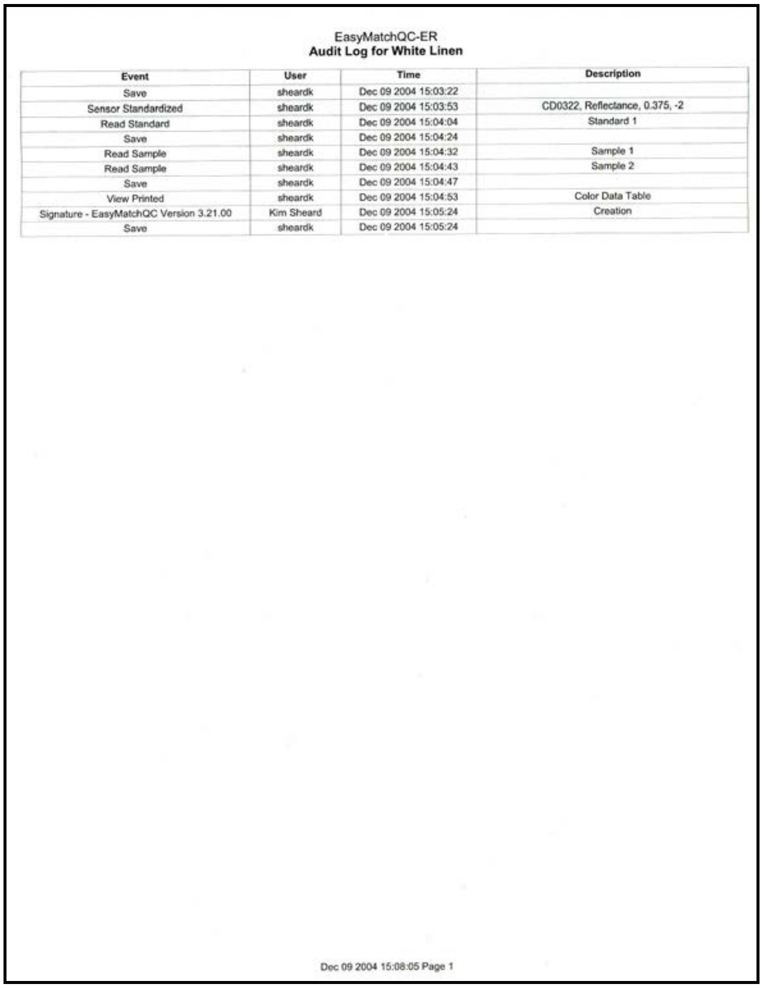
Job Tree is not displayed.

View/Audit Log (-ER Version Only)

The **Audit Log** command in the **View** menu allows you to view the audit log for the current job. Select the types of events you would like to view from the drop-down box next to "Filter By." The available choices are Save (the job), Edit, Print (the job or a view), Signature, and All. Click **Print Audit Log** to print the log to the Windows default printer in a fashion similar to that shown at the bottom of this page.



Event	User	Time	Description
Save	sheardk	Dec 09 2004 15:03:22	
Sensor Standardized	sheardk	Dec 09 2004 15:03:53	CD0322, Reflectance, 0....
Read Standard	sheardk	Dec 09 2004 15:04:04	Standard 1
Save	sheardk	Dec 09 2004 15:04:24	
Read Sample	sheardk	Dec 09 2004 15:04:32	Sample 1
Read Sample	sheardk	Dec 09 2004 15:04:43	Sample 2
Save	sheardk	Dec 09 2004 15:04:47	
View Printed	sheardk	Dec 09 2004 15:04:53	Color Data Table
Signature - EasyMatchQC Version ...	Kim Sheard	Dec 09 2004 15:05:24	Creation
Save	sheardk	Dec 09 2004 15:05:24	



EasyMatchQC-ER
Audit Log for White Linen

Event	User	Time	Description
Save	sheardk	Dec 09 2004 15:03:22	
Sensor Standardized	sheardk	Dec 09 2004 15:03:53	CD0322, Reflectance, 0.375, -2
Read Standard	sheardk	Dec 09 2004 15:04:04	Standard 1
Save	sheardk	Dec 09 2004 15:04:24	
Read Sample	sheardk	Dec 09 2004 15:04:32	Sample 1
Read Sample	sheardk	Dec 09 2004 15:04:43	Sample 2
Save	sheardk	Dec 09 2004 15:04:47	
View Printed	sheardk	Dec 09 2004 15:04:53	Color Data Table
Signature - EasyMatchQC Version 3.21.00	Kim Sheard	Dec 09 2004 15:05:24	Creation
Save	sheardk	Dec 09 2004 15:05:24	

Dec 09 2004 15:08:05 Page 1

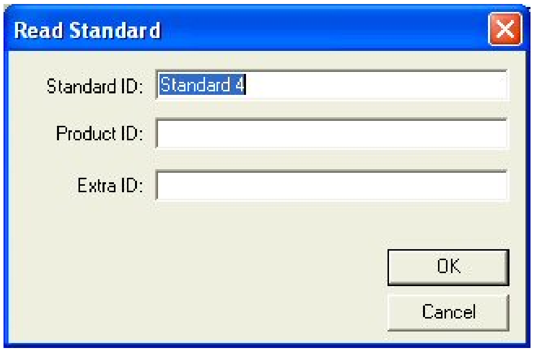
CHAPTER SIX

The Measurements Menu

From the **Measurements** menu you may read either a standard or a sample. You may also average data. The functions available through the **Measurements** menu are described in the remainder of this chapter.

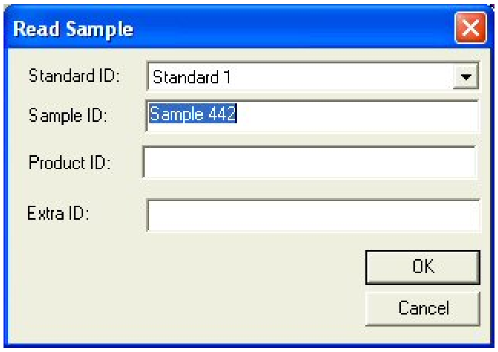
Measurements/Read Standard

The **Read Standard** command in the **Measurements** menu initiates reading of a standard. Place the standard before initiating the **Read Standard** command. If Prompt for standard name was checked in **Naming Conventions** in the **Options** menu, you will then be prompted to enter a name for the standard (as well as a Product ID and Extra ID, if you wish). You may simply accept the name defined using the **Naming Conventions** command, if desired. The measurement is then accepted and added to the current job. The keyboard shortcut for this command is **F2**.



Measurements/Read Sample

The **Read Sample** command in the **Measurements** menu initiates reading of a sample. Place the sample before initiating the **Read Sample** command. If Prompt for sample name was checked in **Naming Conventions** in the **Options** menu, you will then be prompted to enter a name for the sample (as well as a Product ID and Extra ID, if you wish) and to choose the standard with which the sample should be linked. ("Standard Empty" is a choice if you do not want to link to a standard.) You may simply accept the name defined using the **Naming Conventions** command and the suggested standard, if desired. The measurement is then accepted and added to the current job. The keyboard shortcut for this command is **F3**.



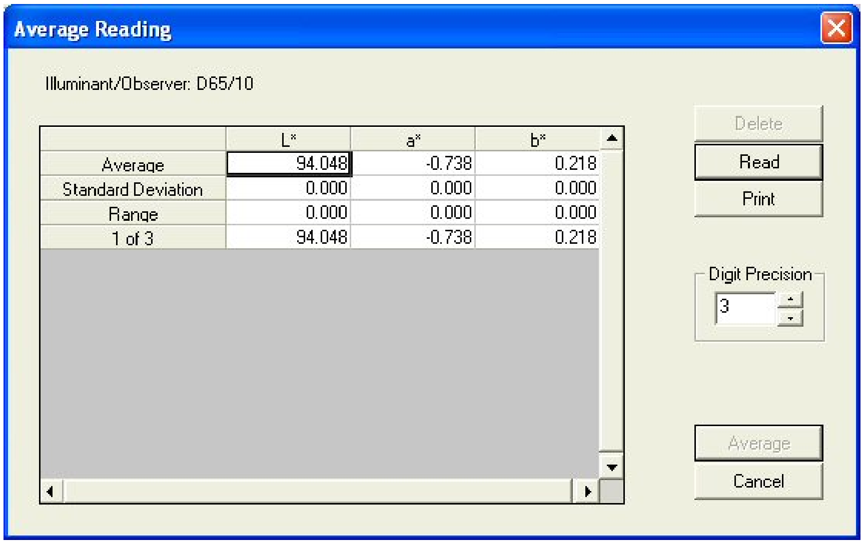
Measurements/Read Series

The **Read Series** command in the **Measurements** menu creates a new standard in the current job. This standard has no color values (i.e., L=0, a=0, b=0), but can be used to indicate a tolerance box of color values within which samples must fall to be considered "in-spec." Once the standard is created, select it (and only it) in the Job Tree. Then, right-click on the standard and choose **Properties**. Click the **Tolerances** button to obtain a Tolerances screen on which you can enter the tolerance box desired by entering the minimum (min) and maximum (max) acceptable values for each parameter of the color scale. Samples that are read and assigned to this standard will then be compared to this tolerance box.

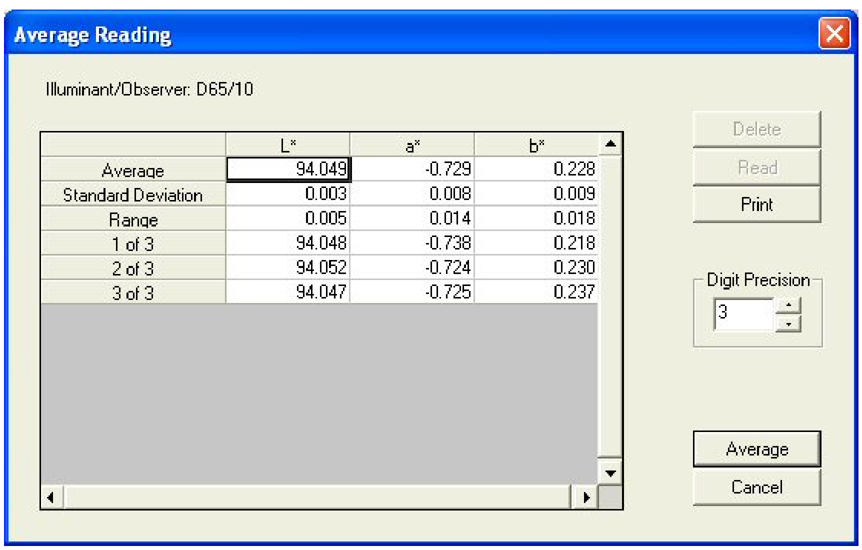
The keyboard shortcut for this command is **F5**. See Lesson 11 for an example of using a data series.

Measurements/Average

The **Average** command in the **Measurements** menu, when checked, initiates on reading the **Average Method** selected in the **Options** menu. After the first reading is taken, the following screen appears.



Click **Read** to initiate each additional reading in the set of readings and **Average** to complete the average and add the averaged measurement to the job. You may also delete individual readings in the set by highlighting them and clicking **Delete**.



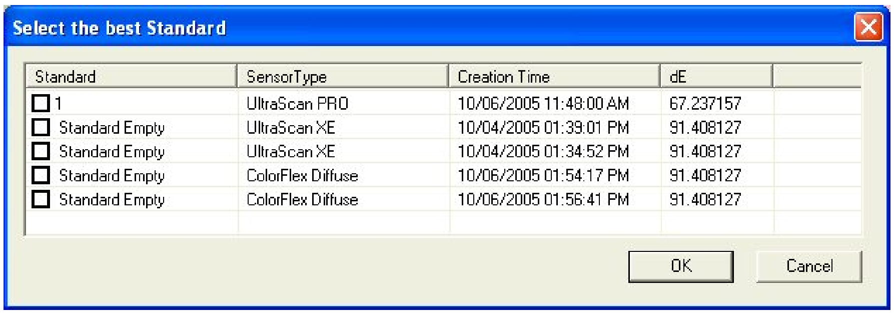
The setting chosen here applies to the current job only.

Measurements/Timed Read

The **Timed Read** command in the **Measurements** menu, when checked, initiates on reading the timed read method selected using the **Configure Timed Read** command in the **Options** menu. When Read Sample is chosen, measurements are made at the interval chosen until the number of measurements indicated have been made or until the **Read Sample** button on the toolbar is clicked. The setting chosen here applies to the current job only.

Measurements/Automatic Standard Search

The **Automatic Standard Search** command in the **Measurements** menu, when checked, initiates on reading the automatic standard search function as configured using the **Configure Automatic Standard Search** command in the **Options** menu. When **Automatic Standard Search** is chosen and measurement of a sample is initiated, either the one standard contained in the database that is closest to that read sample is automatically recalled into the job and linked to the sample, or the closest five standards are offered for selection. The setting chosen here applies to the current job only.



Screen that appears when the automatic standard search configuration is “Choose standard from list of 5.”

Measurements/Average Selected to Measurement

The **Average Selected to Measurement** command in the **Measurements** menu creates a new sample that is the arithmetic average of all the measurements currently highlighted in the Job Tree. You are prompted to choose the standard to which this new sample will be linked and allowed to name the sample.

If spectral reflectance or transmittance data is available for all the measurements being averaged, this spectral data will be averaged in creating the new sample. If spectral reflectance or transmittance data is not available for any or all of the measurements being averaged, CIE XYZ data will be averaged in creating the new sample.

Measurements/Average Selected to Standard

The **Average Selected to Standard** command in the **Measurements** menu averages the items that are currently selected (highlighted) in the Job Tree and replaces the current standard on the branch with the averaged measurement, while retaining the current standard name.

If spectral reflectance or transmittance data is available for all the measurements being averaged, this spectral data will be averaged in creating the standard. If spectral reflectance or transmittance data is not available for any or all of the measurements being averaged, CIE XYZ data will be averaged in creating the standard.

Measurements/Average Selected to New Standard

The **Average Selected to New Standard** command in the **Measurements** menu averages the items currently selected (highlighted) in the Job Tree and creates a new standard for the averaged measurement, which you are prompted to name.

If spectral reflectance or transmittance data is available for all the measurements being averaged, this spectral data will be averaged in creating the new standard. If spectral reflectance or transmittance data is not available for any or all of the measurements being averaged, CIE XYZ data will be averaged in creating the new standard.

CHAPTER SEVEN

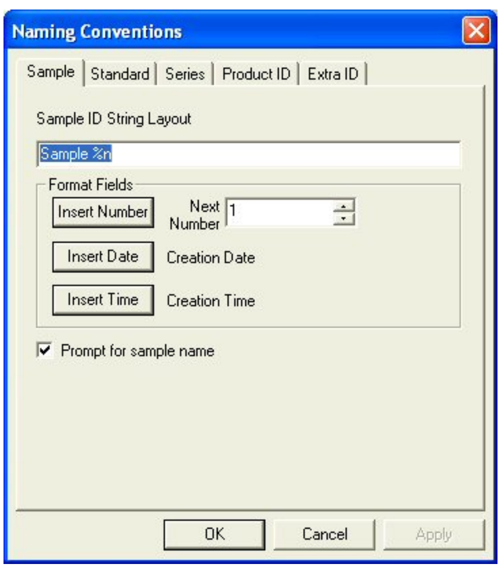
The Options Menu

From the **Options** menu you can set various preferences concerning your use of the software, such as your naming conventions and default tolerances. The functions available through the **Options** menu are described in the remainder of this chapter.

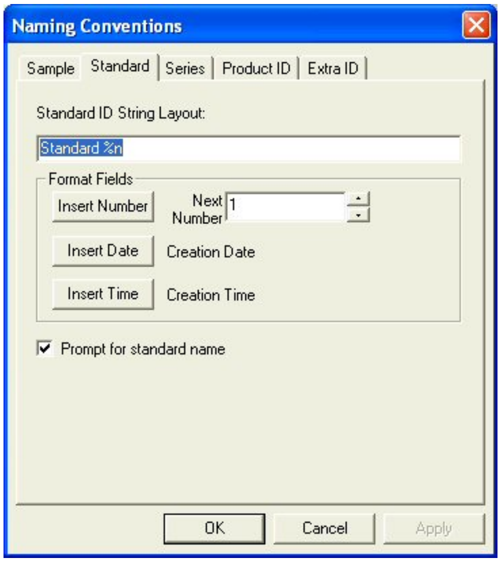
Options/Naming Conventions

The **Naming Conventions** command in the **Options** menu allows you to establish naming conventions that will be used when standards and samples are read in all jobs by default (when **Global** is chosen from the submenu) or in the current job (when **Job** is chosen from the submenu).

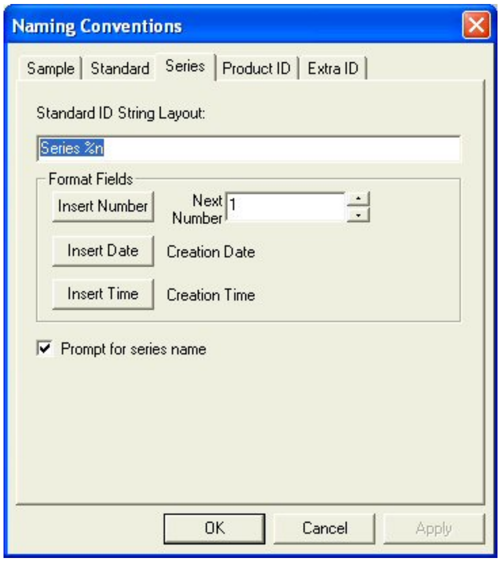
There are four tabs available on the Naming Conventions screen. The **Sample** tab allows you to set the default naming convention for your samples. You may type any desired text into the Sample ID String Layout box. You may also insert a number to be automatically incremented with each sample read, and/or insert the date and time the sample is read to be automatically applied to the sample. You may override the default name by typing a new one into the box that appears when reading is initiated as long as the Prompt for sample name box is checked. If this box is unchecked, the naming convention will be used automatically without allowing you to override it.



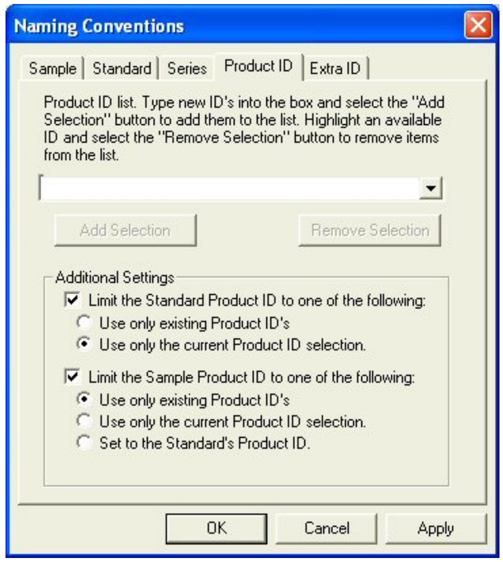
The **Standard** tab allows you to set the default naming convention for your standards. You may type any desired text into the Standard ID String Layout box. You may also insert a number to be automatically incremented with each standard read, and/or insert the date and time the standard is read to be automatically applied to the standard. You may override the default name by typing a new one into the box that appears when reading is initiated as long as the Prompt for standard name box is checked. If this box is unchecked, the naming convention will be used automatically without allowing you to override it.



The Series ID tab allows you to set the default naming conventions for your data series. You may type any desired text into the Series ID String Layout box. You may also insert a number to be automatically incremented with each series created, and/or insert the date and time the series is created to be automatically applied to the series. You may override the default name by typing a new one into the box that appears when reading is initiated as long as the Prompt for series name box is checked. If this box is unchecked, the naming convention will be used automatically without allowing you to override it.

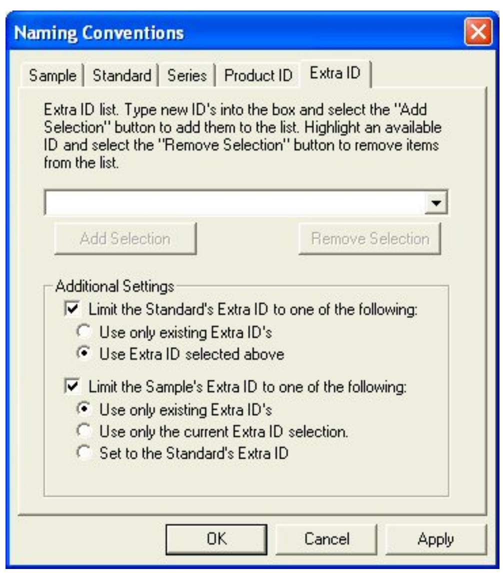


The Product ID tab allows you to set the default product IDs for your standards and samples. A list of Product IDs may be maintained and chosen on this tab. Type text for a new Product ID into the box and then click **Add Selection** to add it to the list. Choose an ID to be deleted from the drop down box and click **Remove Selection** to remove it from the list. The ID that is currently selected from the drop-down box is the one that will be automatically applied on reading.



At the bottom of the screen, you may choose to limit your Standard Product IDs to only those that already exist, to the current selection in the drop-down box, or neither. You may choose to limit your Sample Product IDs to those that already exist, to the current selection in the drop-down box, to the Standard Product ID, or none of these options.

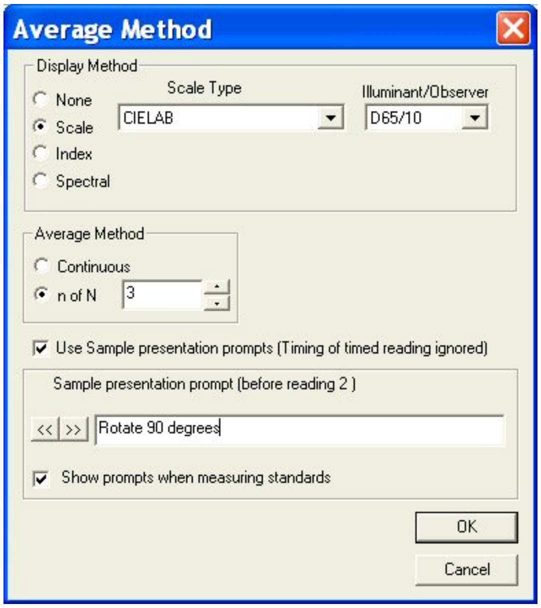
The Extra ID tab allows you to set the default extra IDs for your standards and samples. A list of Extra IDs may be maintained and chosen on this tab. Type text for a new Extra ID into the box and then click **Add Selection** to add it to the list. Choose an ID to be deleted from the drop down box and click **Remove Selection** to remove it from the list. The ID that is currently selected from the drop-down box is the one that will be automatically applied on reading.



At the bottom of the screen, you may choose to limit your Standard Extra IDs to only those that already exist, to the current selection in the drop-down box, or neither. You may choose to limit your Sample Extra IDs to those that already exist, to the current selection in the drop-down box, to the Standard Extra ID, or none of these options.

Options/Average Method

The **Average Method** command in the **Options** menu allows you to indicate the method by which you wish to average when standard and sample measurements are made in the current job.



The Display Method controls the information shown in the averaging window while you are taking measurements. For Display Method you can select None, Scale, Index, or Spectral. For Scale or Index you must also choose the scale or index, illuminant, and observer that will appear in the averaging window while you are taking readings.

*Note: The Average box will display color values based on the parameters set using the **Average Method** command. These color values will not match those shown in the Color Data Table unless the scale, illuminant, and observer match for the average method and the Color Data Table.*

In the Average Method area, you may select Continuous or n of N. If you select Continuous, then you can monitor the running average of the measurements each time you choose to read and terminate the readings (by clicking **Average**) when the running average stabilizes. If you select n of N, then you can average a specified number of readings for each measurement.

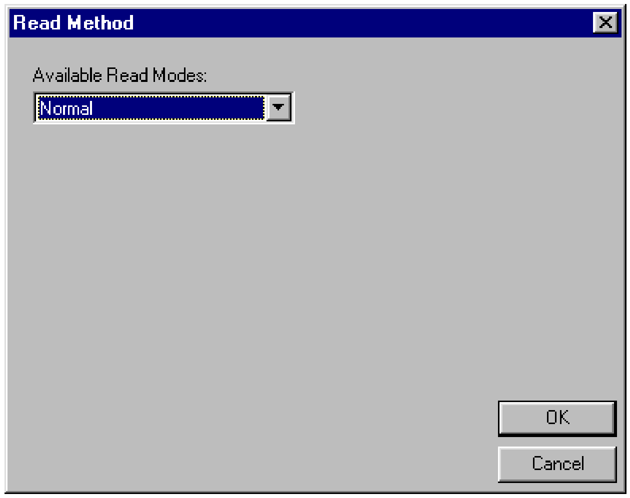
Check the box next to Use Sample presentation prompts if you wish to enter a helpful prompt to be shown before each reading to guide your users through the averaging sequence. Once the box is checked, enter the prompt for the first reading into the white box. Click the right arrow (>>) button and enter each successive prompt until the last reading in the sequence is reached. Check Show prompts when measuring standards if you wish your prompts to be shown when measuring standards, in addition to when measuring samples.

Note: If the timed read feature is also being used, its timing will be ignored to give you a chance to follow the prompts before each reading.

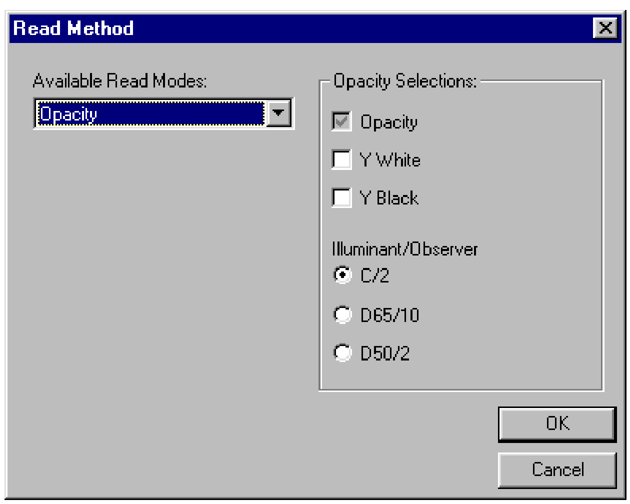
Refer to Lesson 12 in Chapter 2 for specific instructions on averaging.

Options/Read Method

When you select **Read Method** from the **Options** menu you can select to use, in this job, one of the types of special read methods that are available for the sensor you are using. These are types of measurement that require more than one reading to obtain a result. If you select **Normal** then the measurement is either a single reading or an average of multiple readings.



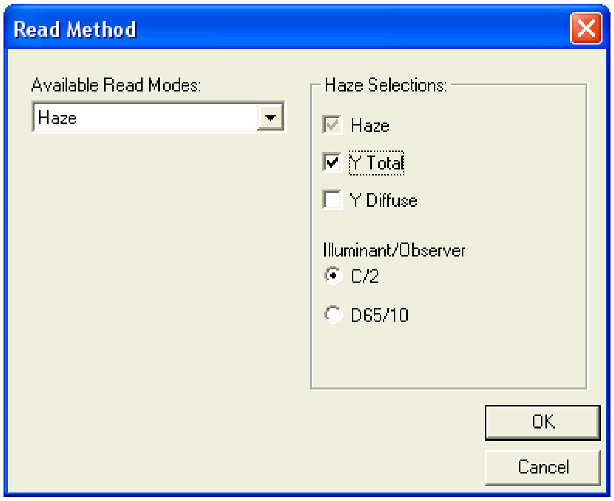
If you select **Opacity**, each measurement requires two readings, one with the sample backed by white and one with the sample backed by black. In the Opacity Selections area, you may choose to display Y White and/or Y Black in your Color Data Table view in addition to Opacity by checking the desired boxes. Also choose the Illuminant/Observer combination for which you would like to display opacity.



Note: Opacity is not available with the ColorQuest XT.

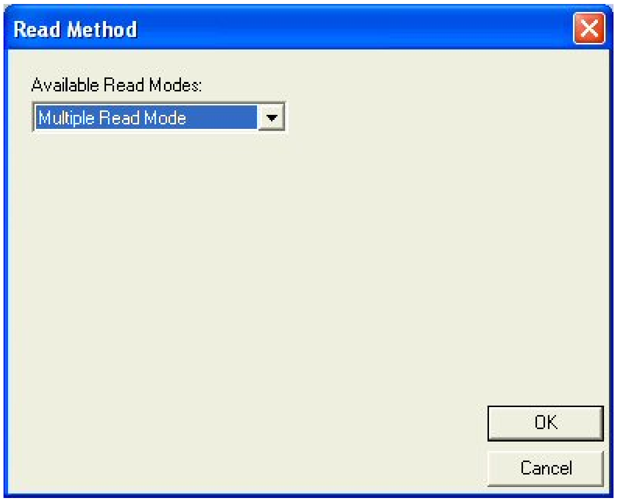
Note: When opacity is chosen, the colorimetric values displayed after both readings represent the sample over white.

If you select **Haze** the measurement also requires two readings, one with the instrument white tile at the reflectance port and one with the light trap at the port. In the Haze Selections area, you may choose to display Y Total and/or Y Diffuse in your Color Data Table view in addition to Haze by checking the desired boxes. Also choose the Illuminant/Observer combination for which you would like to display Haze.



Note: Haze is available only with the ColorQuest XE, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, and UltraScan VIS sensors.

If you select **Multiple Read Mode**, two readings are made and displayed each time measurement is initiated, one in each of the two standardization modes chosen using the **Configure Multi Mode** command in the **Sensor** menu.



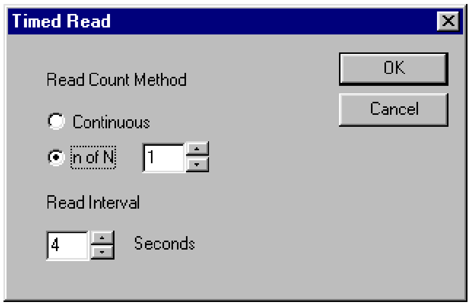
Note: Multiple Read Mode is available only with the ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, and UltraScan VIS sensors.

*Note: The averaging feature activated by clicking **Average** in the **Measurements** menu cannot be used in conjunction with multimode reading. You may average selected readings that result from the multimode reading after the readings are completed by using the **Average Selected to...** commands in the **Measurements** menu.*

The current read method controls how standard and sample measurements are taken. Be sure that the sensor is standardized in RSIN (or the normal reflectance mode for a 45°/0° or 0°/45° instrument) mode when using opacity and in TTRAN mode when using haze.

Options/Configure Timed Read

The **Configure Timed Read** command in the **Options** menu allows you to select how you wish EasyMatch QC to automatically perform sample readings within the current job at a specified time interval.

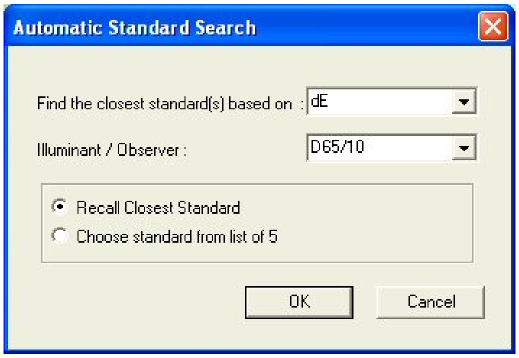


Select the Read Count Method desired. You may choose either continuous readings or a fixed number of readings between 1 and 1000. Also select the Read Interval (time between the end of one reading and the beginning of the next reading) desired. You may choose from 4 to 60 seconds. Click on **OK** to accept the parameters.

Note: Also select (check) ***Timed Read*** *in the* ***Measurements*** *menu in order to actually activate the timed readings you configured here.*

Options/Configure Automatic Standard Search

The **Configure Automatic Standard Search** command in the **Options** menu allows you to specify how you would like automatic standard searching to be performed in the current job. This feature is initiated when you read a sample, at which time the sample is compared to all standards currently saved in the database. The standard that is closest in color to the sample is recalled into the current job and linked to the read sample.

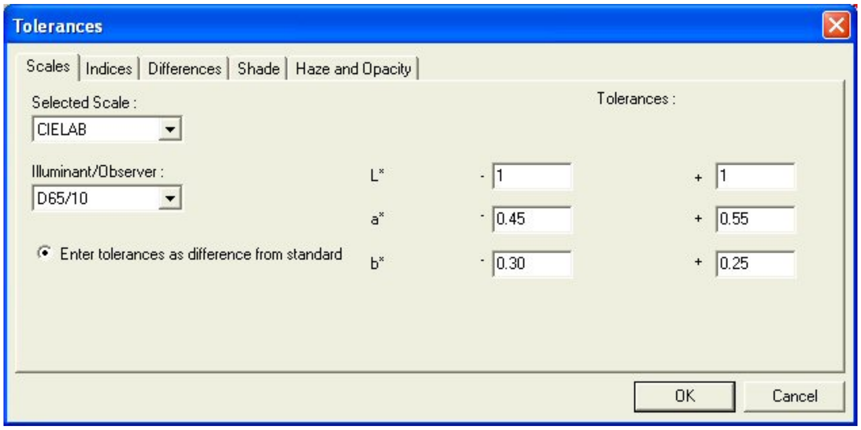


Select the parameter for which the sample-standard comparison will be performed. Your choices are dE, dE CMC, and dE*. Also select the illuminant/observer combination under which the comparison will be performed and whether you wish to automatically recall the closest standard to the sample or choose from a list of the closest five standards. Click **OK** to accept the parameters.

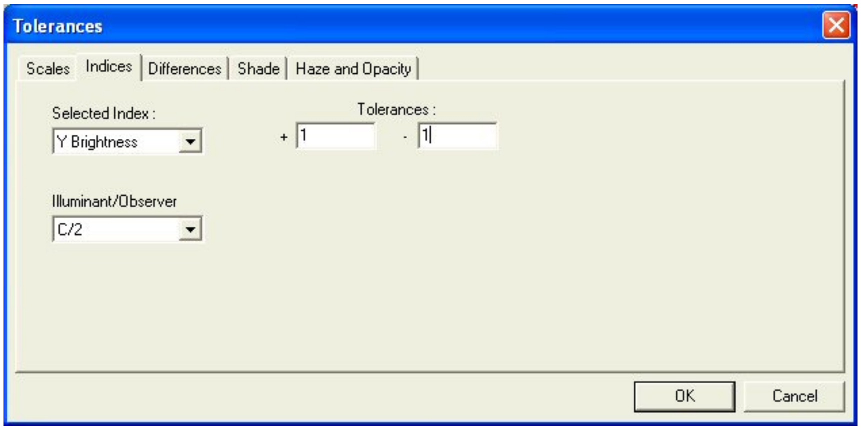
> *Note: Also select (check) **Automatic Standard Search** in the **Measurements** menu in order to actually activate the automatic standard searching you configured here.*

Options/Default Tolerances

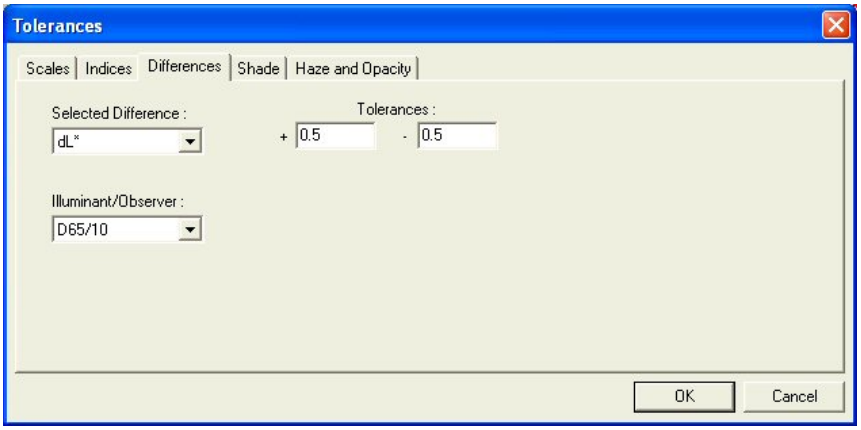
The **Default Tolerances** command in the **Options** menu allows you to set the tolerances that will be assigned to new standards in the current job by default. You may set tolerances for as many scales, indices, and differences for as many illuminant/observer combinations as you wish. You may override the default tolerances after a standard is read by choosing **Properties** from the menu that appears when right-clicking on the standard in the Job Tree.



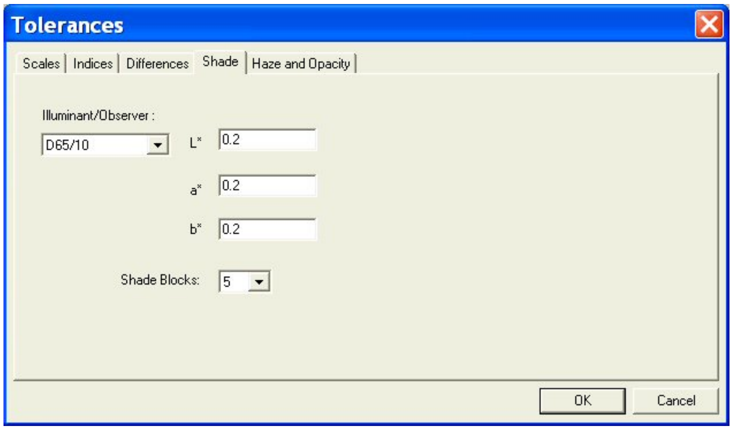
On the **Scales** tab, set all tolerances you wish to assign based on color scales. Choose the color scale from the Selected Scale drop-down box and the illuminant/observer combination from the Illuminant/Observer drop-down box. Then enter the upper and lower tolerance limits (the allowable differences from the standard values) for each of the three components of the color scale for this illuminant/observer combination. Then enter tolerances for all other scales and illuminant/observer combinations desired by choosing each one individually and typing the tolerance values. It is not necessary to click **OK** after entering each set of tolerances. Clicking **OK** once will cause all tolerances entered to be accepted.



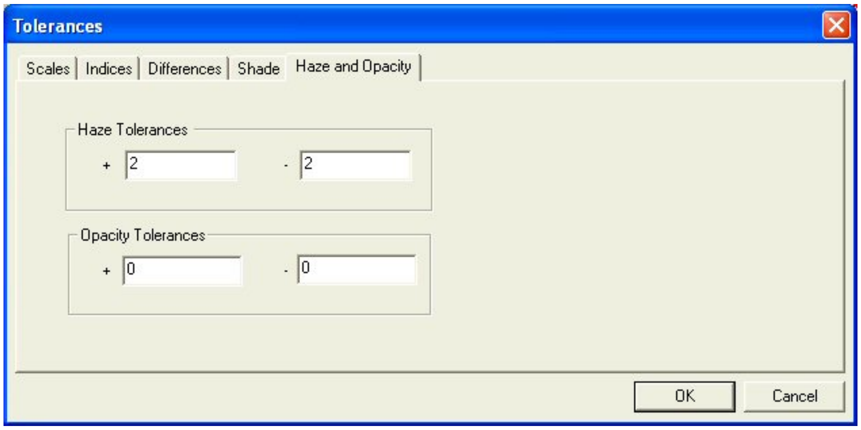
On the **Indices** tab, set all tolerances you wish to assign based on indices. Choose the index from the Selected Index drop-down box and the illuminant/observer combination from the Illuminant/Observer drop-down box. Then enter the upper and lower tolerance limits (the allowable difference from the standard value) for the index for this illuminant/observer combination. Then enter tolerances for all other indices and illuminant/observer combinations desired by choosing each one individually and typing the tolerance values. It is not necessary to click **OK** after entering each set of tolerances. Clicking **OK** once will cause all tolerances entered to be accepted.



On the **Differences** tab, set all tolerances you wish to assign based on color differences. Choose the difference from the Selected Difference drop-down box and the illuminant/observer combination from the Illuminant/Observer drop-down box. Then enter the upper and lower tolerance limits for the difference for this illuminant/observer combination. Then enter tolerances for all other differences and illuminant/observer combinations desired by choosing each one individually and typing the tolerance values. It is not necessary to click **OK** after entering each set of tolerances. Clicking **OK** once will cause all tolerances entered to be accepted.



On the **Shade** tab, enter the tolerance you wish to use for the first, second, and third traces, which will be the three parameters of your color scale (i.e., L*a*b*, L*C*h). Also select the number of shade blocks to be contained within your pass/fail tolerance. For instance, If you choose 5, the blocks within your tolerance will be 3, 4, 5, 6, and 7. In the example shown above, the pass/fail tolerance is 0.2 for each color scale parameter, and 5 shade blocks will fit within that tolerance value.

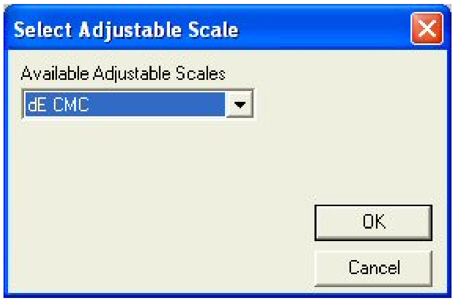


On the **Haze and Opacity** tab, enter the tolerances you wish to use for the haze and opacity read methods.

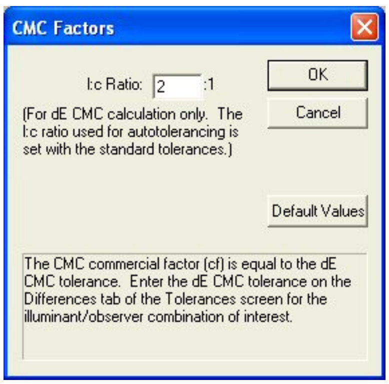
Click **OK** to accept the default tolerances and close the Tolerances screen.

Options/Adjust Scale Factors

The **Adjust Scale Factors** command in the **Options** menu allows you to set various factors used in the calculations for dE CMC, dE CIE94, DIN99, and dE* 2000 differences, plus the ASTM D1500-33mm and Saybolt-50/100mm indices when using a ColorQuest XE, ColorQuest XT, UltraScan XE, UltraScan PRO, or UltraScan VIS. The factors chosen here apply to all jobs used in this installation of EasyMatch QC.



When the Select Adjustable Scale screen appears, first choose the scale of interest from the drop-down box. Then, click **OK**. The screen where the desired factors may be entered appears.

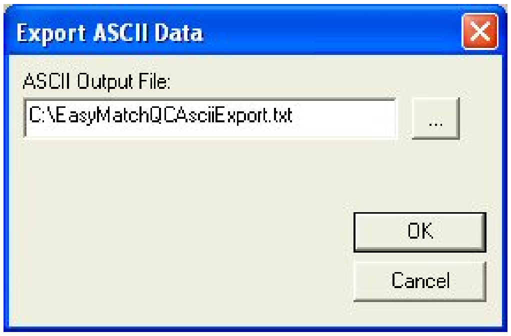


Enter the factors desired or click the **Default Values** button to return the factors to their default values. Click **OK** to begin using the new factors.

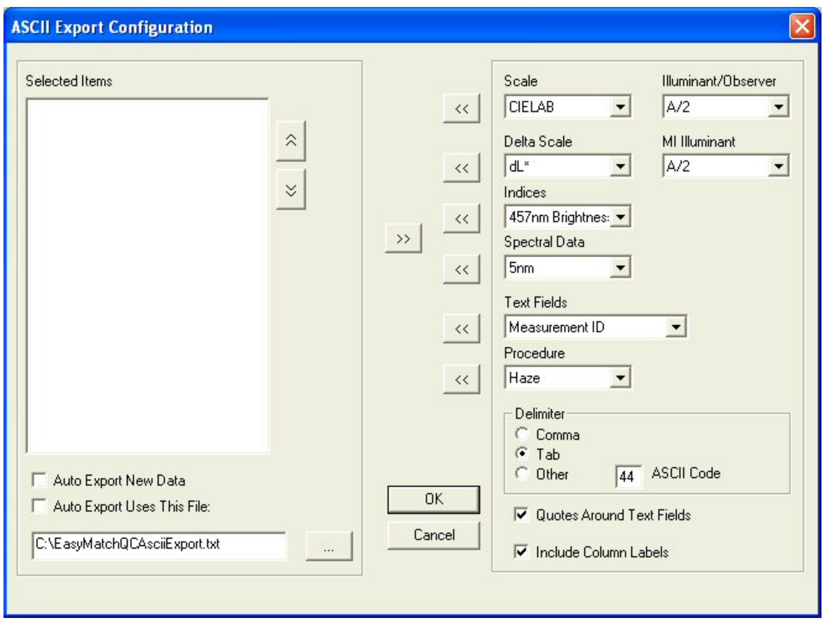
Options/ASCII Export

The **ASCII Export** command in the **Options** menu opens a submenu with two commands: **Export Data** and **Configure**.

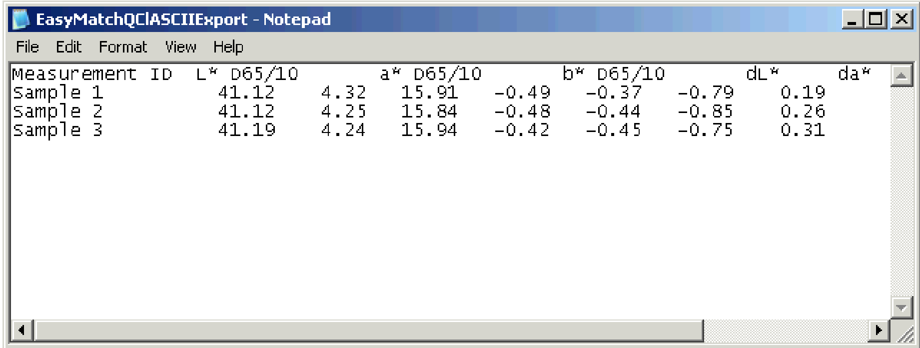
The **Export Data** option initiates export of the readings that are currently highlighted in the Job Tree in the format that was chosen using the **Configure** command, described below. You are first prompted for the output file name, and then the data is sent to the file when you click **OK**.



The **Configure** option allows you to choose the parameters you would like to export when **Export Data** is selected. The screen below is obtained.



The information currently selected for export is displayed on the left side of this window, and all of the available parameters are listed on the right side of the window. Select each desired item from the drop-down menus on the right side of the window and then click on the **left arrow** (<<) button nearest to the item to move the item into the Selected Items list. Highlight each item to delete on the left side of the window and click the **right arrow** (>>) button to remove it from the list. The **up arrow** and **down arrow** buttons allow you to move selected items up or down the list. Also enter (or browse for) the directory and name for the export file in the box below "Auto Export Uses This File." The file extension .CSV will automatically be appended if you chose to export to a comma-delimited file. .TXT will be appended for all other types of files. Long file names with spaces and network paths are all acceptable for use. Click **OK** when all selections have been made. A sample output is shown below.



EasyMatchQCIASCIIExport - Notepad

File Edit Format View Help

```
Measurement ID  L* D65/10       a* D65/10       b* D65/10       dL*     da*
Sample 1        41.12   4.32    15.91   -0.49   -0.37   -0.79   0.19
Sample 2        41.12   4.25    15.84   -0.48   -0.44   -0.85   0.26
Sample 3        41.19   4.24    15.94   -0.42   -0.45   -0.75   0.31
```

Each job may have its own ASCII export configuration. Multiple jobs may export to the same file as long as all the jobs have the same ASCII export configuration.

Column headers are written to the top of the file when the file is first created. From that point on, only data is appended to the file (not headers).

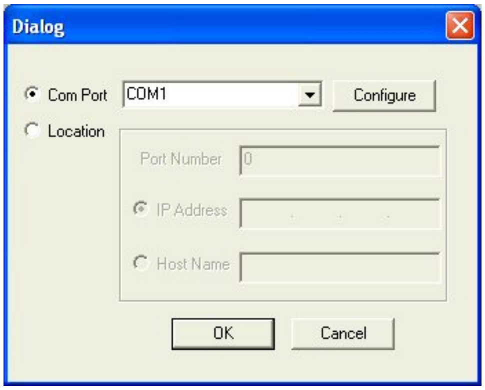
> *Note: Beware that if you later change the ASCII export configuration without opening a new file, the file header may no longer accurately reflect the contents of the file.*

When differences are exported, they are relative to the standard to which the sample is linked, NOT the standard currently being displayed in your data views.

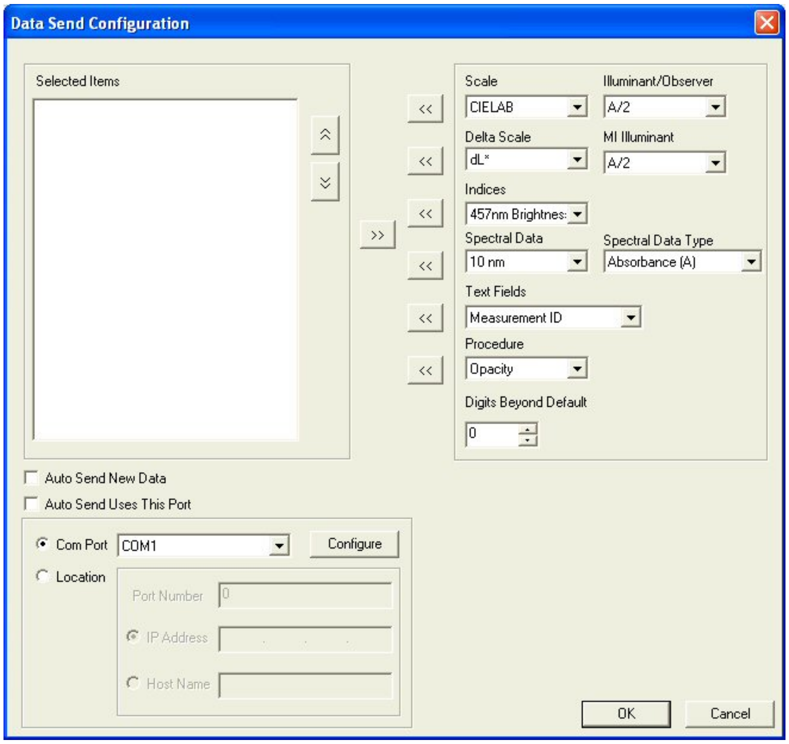
Options/Data Send

The **Data Send** command in the **Options** menu opens a submenu with two commands: **Send Data** and **Configure**.

The **Send Data** option initiates sending the readings that are currently highlighted in the Job Tree in the format that was chosen using the **Configure** command, described below. You are first prompted for the output device, and then the data is sent to the device when you click **OK**.

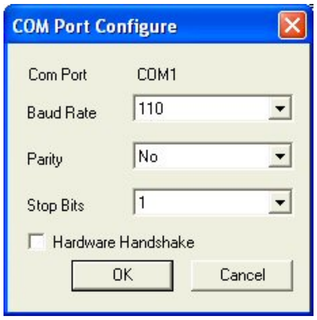


The **Configure** option allows you to choose the parameters you would like to send when **Data Send** is selected. The screen below is obtained.



The information currently selected for sending is displayed on the left side of this window, and all of the available parameters are listed on the right side of the window. Select each desired item from the drop-down menus on the right side of the window and then click on the **left arrow** (<<) button nearest the item to move the item into the Selected Items list. Highlight each item to delete on the left side of the window and click the **right arrow** (>>) button to remove it from the list. The **up arrow** and **down**

arrow buttons allow you to move selected items up or down the list. Also enter the device definition for the send in the box below "Auto Send Uses This Port." Click **Configure** to define all COM port parameters. Click **OK** when all selections have been made.

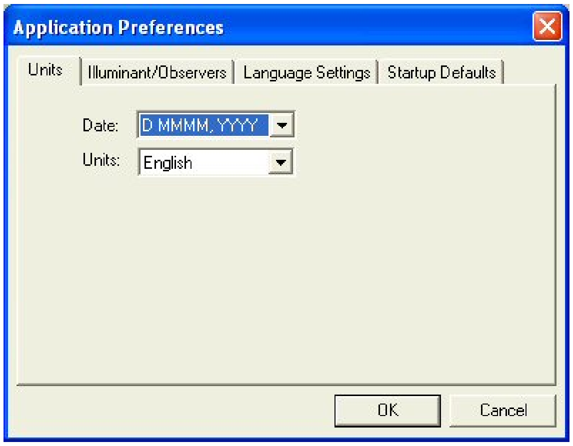


Each job may have its own data send configuration. Multiple jobs may send to the same device as long as the device is ready.

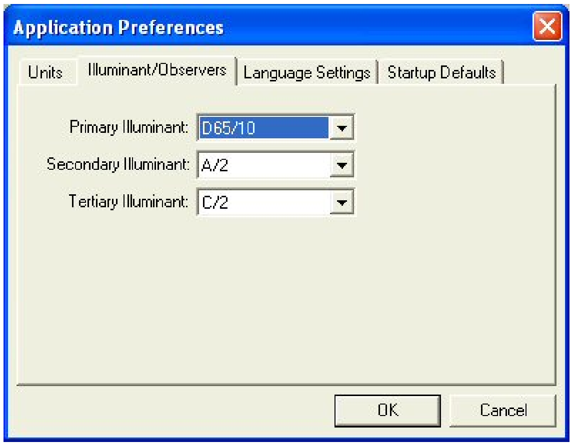
When differences are exported, they are relative to the standard to which the sample is linked, NOT the standard currently being displayed in your data views.

Options/Application Preferences

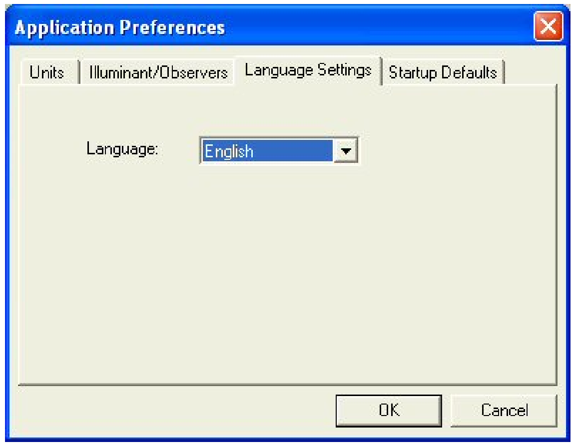
The **Application Preferences** command in the **Options** menu allows you to set various preferences concerning your use of the software. These preferences apply globally when EasyMatch QC is in use, no matter which job or jobs are open.



On the **Units** tab shown above, choose the date format and type of length units (English or metric) you wish to use.

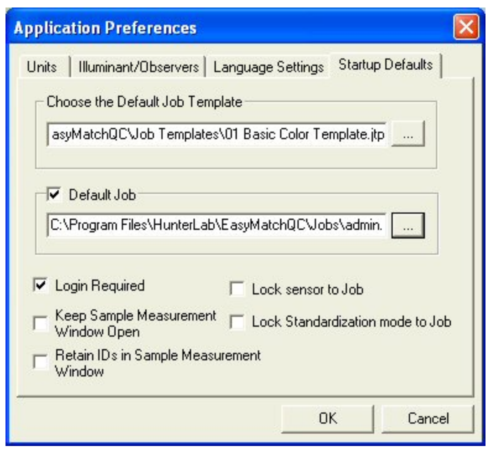


On the **Illuminant/Observers** tab, choose the three illuminant/observer combinations you would like to use in new data views by default. These illuminants may later be changed in individual views as desired.

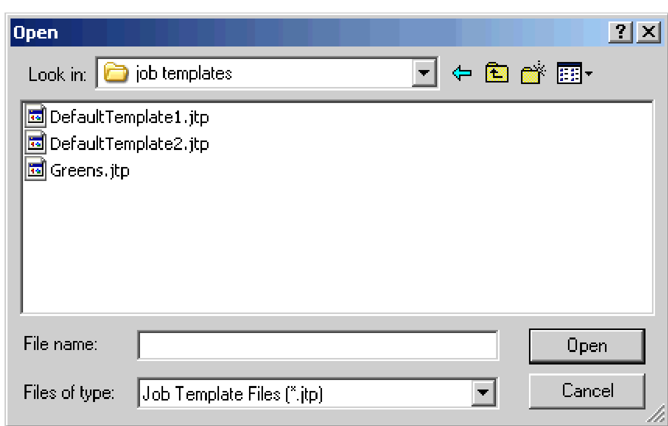


On the **Language Settings** tab, you may set the language in which the software text will presented. Choices are English, Spanish, German, Italian, French, Japanese, and Chinese.

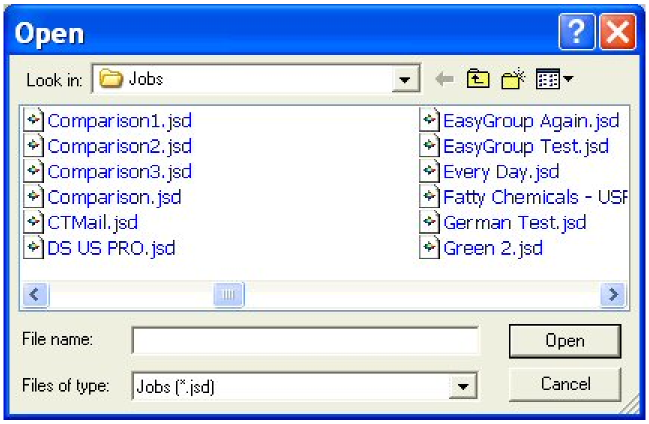
*Note: The keyboard shortcut **Ctrl** + **E** returns the software to English.*



On the **Startup Defaults** tab, you may indicate the name of the job template you would like to use by default when new jobs are opened. Clicking the button with three dots on it allows you to browse for the appropriate template file.



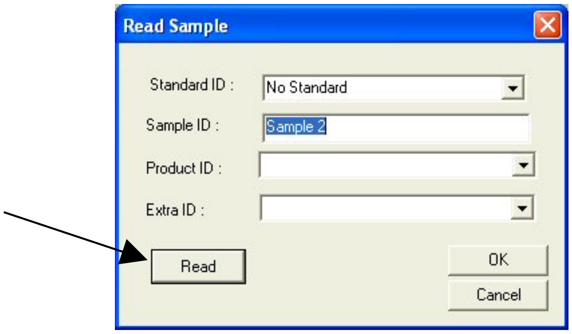
You may also choose to have the software open a specific job or jobs each time it is booted. Clicking the button with three dots on it allows you to browse for the appropriate job file(s). To select more than one job to open, press and hold the **Ctrl** key on your keyboard while clicking your mouse on each desired job.



Also indicate whether you wish software log-in to be required (checked) or not required (unchecked) in order for the software to open.

Note: When Login Required is checked, the default administrator user name "admin" and password "hunterlab" may be used for initial entry to the software and configuration of user accounts.

When the Keep Sample Measurement Window Open box is checked, a **Read** button is added to the Read Sample screen and this window remains open after a sample is read. You may then click **Read** to make another reading. This change applies to the reading of samples only, not standards.



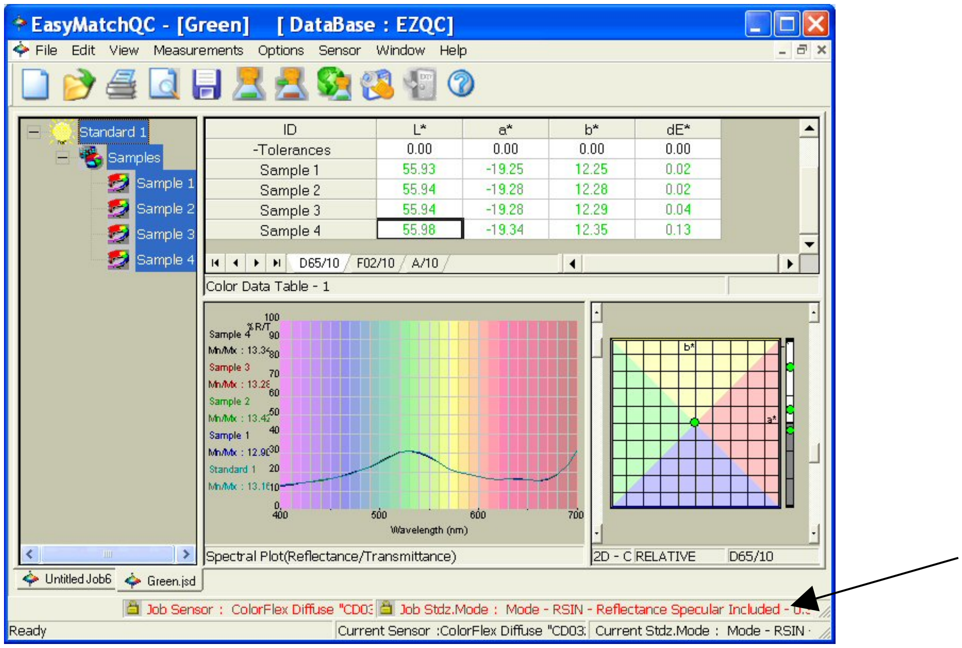
When the Retain IDs in Sample Measurement Window is checked, the last sample ID used is displayed on the Read Sample screen when another sample reading is initiated. This allows you to use the ID again or modify it without having to retype it. This retention applies to the reading of samples only, not standards.

When the Lock sensor to Job box is checked, the current job may be used to hold only readings made with the sensor type (i.e., LabScan XE or UltraScan PRO) attached to the job. Measurements made with other sensor types may not be read or recalled into this job.

When the Lock Standardization mode to Job box is checked, the current job may be used to hold only readings made using the standardization mode (i.e., RSIN, 1.000 inch area of view, UV filter nominal) attached to the job. In fact, when a job that is locked to a standardization mode is opened or made active, the sensor automatically switches to the locked standardization mode without requiring use of the **Sensor**/**Set Modes** command.

If both boxes are checked at the same time, the current job will be locked to a single sensor type and standardization mode.

When either or both of these boxes is checked, a second level of status bar is shown at the bottom of the EasyMatch QC screen, showing the job's sensor type and the job's standardization mode. The lower status bar continues to show the current sensor and standardization mode.

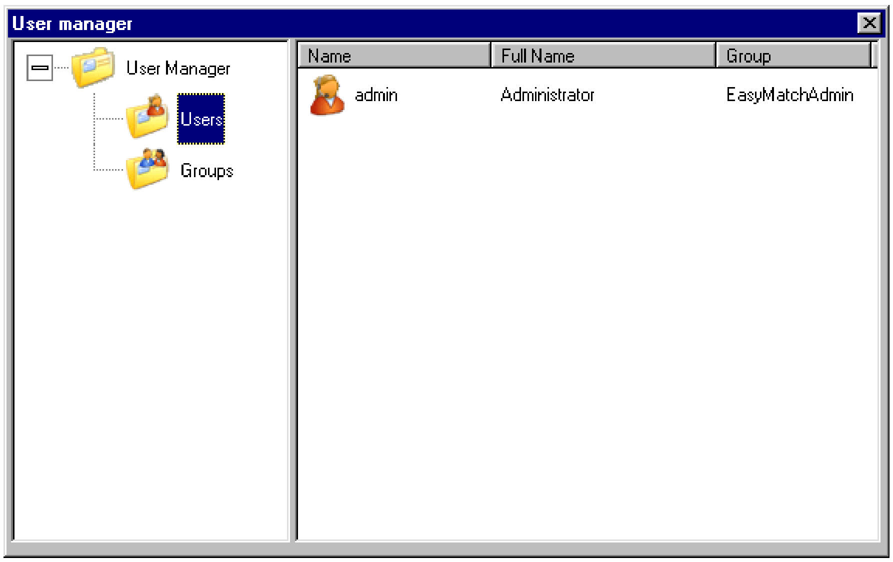


Options/System Configuration

The **System Configuration** command in the **Options** menu yields a submenu that allows you to choose to configure user accounts and privileges or configure data storage. These parameters will be used throughout the software, no matter what job or jobs are in use.

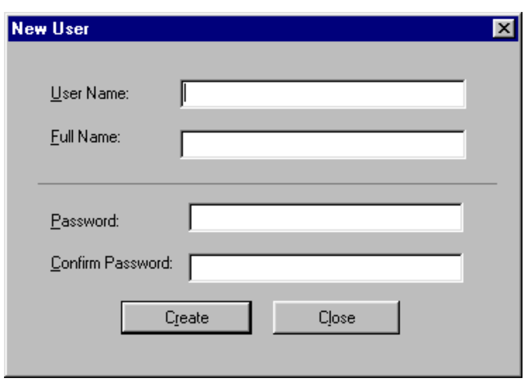
User Manager

The user manager allows you to configure accounts for system users and assign specific software privileges to those accounts. When the User Manager screen appears, you may click on Users to view the users already in the system.



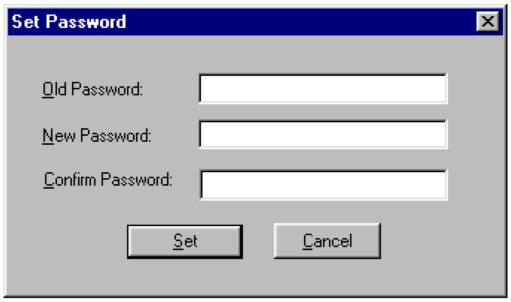
*Note: The **User Manager** command is available only if Login Required is checked on the **Startup Defaults** tab available by choosing **Application Preferences** from the **Options** menu.*

Right-click on **Users** to display a pop-up menu with one command: **New User**. **New User** brings up a screen on which you may create a new user account. Click **Create** to actually create the account. This user may log into EasyMatch QC using the account name and password chosen here.

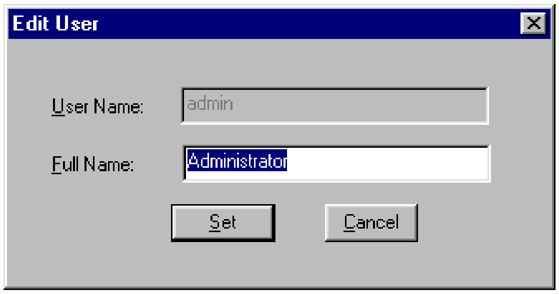


On the right side of the screen, right-click on a user name to receive a pop-up menu containing the following commands:

- **Set Password:** Choose this command and enter the old password then the new password twice to change this user's password.

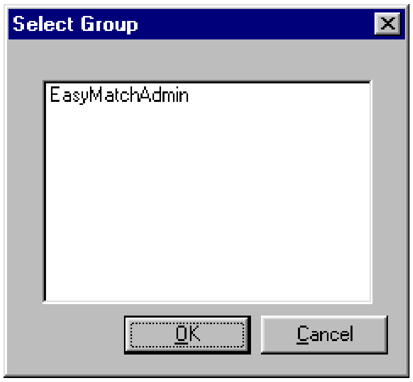


- **Edit:** Choose this command to edit the full name for this user.

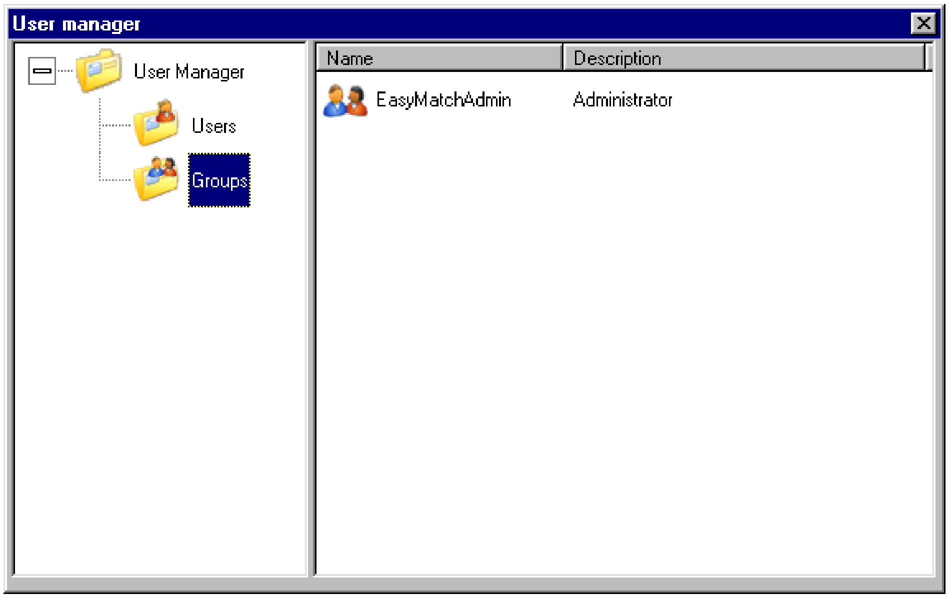


- **Delete:** Choose this command to delete this user.

- **Add to Group:** Choose this command to obtain a list of available groups. Click on the group desired and then **OK** to add this user to the chosen group.

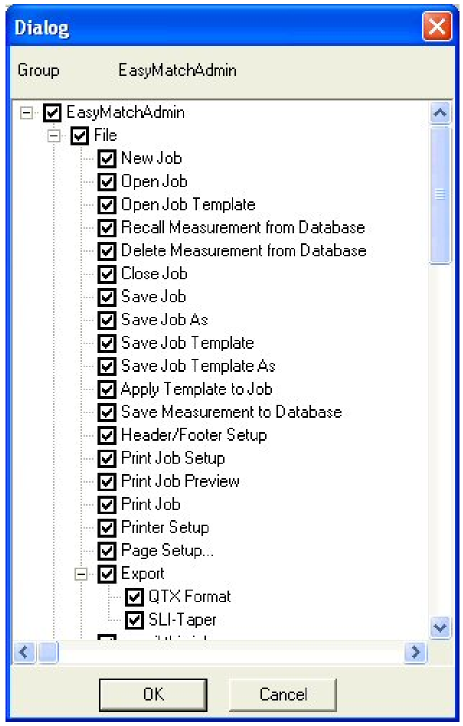


Click on **Groups** to view the groups already in the system.



Right-click on **Groups** to display a pop-up menu with one command: **New Group**. **New Group** brings up a screen on which you may create a new group. Click **Add** to add users to the group and **Remove** to remove any highlighted users from the group. Click **Create** to actually create the group.

Click **Set Privileges** to configure the privileges for the group. Each menu command may be allowed or prohibited individually. Click the plus (+) sign next to an item to open a list of its subitems. Check the box near each command that should be allowed and clear the box for each command that should be prohibited.



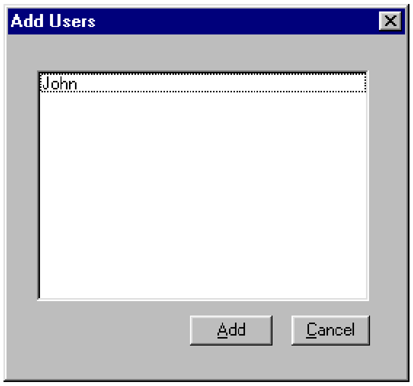
For 21 CFR 11 compliance, the following commands should be prohibited for users that are not the system administrator:

- File/Delete Measurement From Database
- File/Time Synchronization
- Edit/Cut
- Edit/Delete
- View/Audit Log
- Sensor/Set Interval
- Options/User Manager
- Options/Data Storage.

You may wish to further limit the privileges of lower-level operators.

On the right side of the User manager screen, right-click on a group name to receive a pop-up menu containing the following commands:

- **Add User:** Choose this command to add an existing user to this group. A list of users that have not yet been assigned to a group appears. Select the desired user and click **Add**.



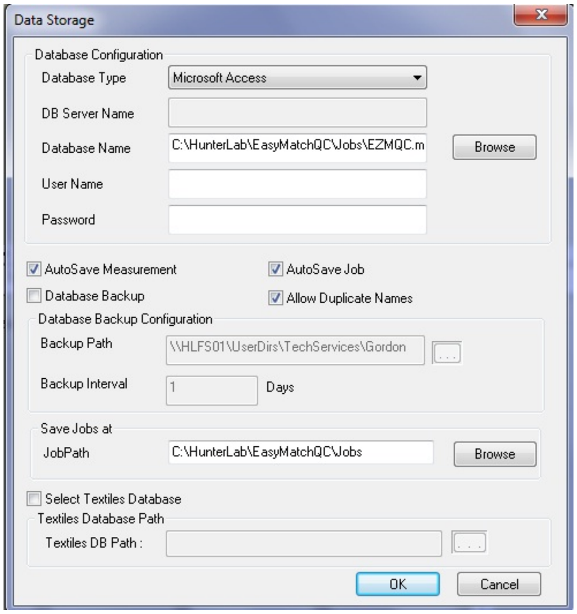
- **Edit Privileges:** Choose this command to edit the privileges of this group. The same screen that was displayed when you initially set the privileges is received.

- **Delete:** Choose this command to delete this group.

Data Storage

The **Data Storage** command allows you to indicate the location where your database will be stored and other parameters related to the database.

Note: Use of a database is optional.



Choose the type of database you wish to use and indicate the location of the database, which may be housed at any location accessible by your computer. If required for database access, enter the user name and password for the database. If you wish to have all measurements saved to the database automatically as they are made, check Auto Save Measurement. You may also have all measurements in all open jobs automatically saved by checking Auto Save Job. If you wish to use the same sample and standard IDs multiple times in a single job or database without receiving an error message, check Allow Duplicate Names. If you wish to periodically have the software back up your database automatically, check Database Backup and indicate where you would like the back-up file to be stored and how often. Indicate the path where you would like your jobs saved by default and, if you wish to import an EasyMatch Textiles database, check Select Textiles Database and indicate the database and its location. Click **OK**. When **Save Measurement to Database** is then chosen from the **File** menu, the chosen measurement(s) will be saved to the configured database.

Note: Microsoft Access need not be installed on the system in order to use the Access database feature.

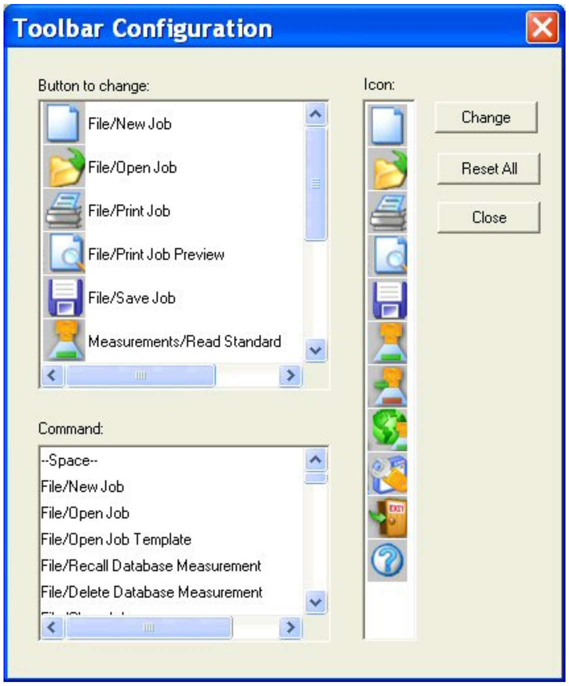
Note: Create and configure a SQL database as described in Appendix D.

Server Settings (-ER Version Only)

At the end of the installation of the EasyMatch QC-ER Client software, the server name was entered. However, if the server name should change or require re-entry, use the **Server Settings** command to do so, then click **OK**.

Options/Customize Toolbar

The **Customize Toolbar** command in the **Options** menu allows you to modify the icons of the buttons on the toolbar and the commands performed by the buttons on the toolbar. This configuration applies to this installation of the software, no matter what job or jobs are in use.



In the Button to change box, select the button you wish to change and then click the icon for the button in the Icon box. Then select a new command for that button from the Command box. Click **Change** to initiate the changes. Click **Reset All** to return all buttons to their default settings. Click **Close** to exit the window after you have made your changes.

Options/EasyGroup

The **EasyGroup** command in the **Options** menu allows you to launch HunterLab's tapering and grouping program, EasyGroup, if you purchased and installed that package. Refer to the User's Guide for EasyGroup for complete operational instructions.

Options/Import EasyGroup Sequence

The **Import EasyGroup Sequence** command in the **Options** menu allows you, once a collection of samples has been grouped or tapered in EasyGroup, to bring the grouping or tapering information back into EasyMatch QC and display it as a new column in the Color Data Table view. The column header is "Group" for grouped samples and "Group/Sequence" for group + tapered samples.

Note: EasyGroup version 1.82 or higher is required in order to use this feature.

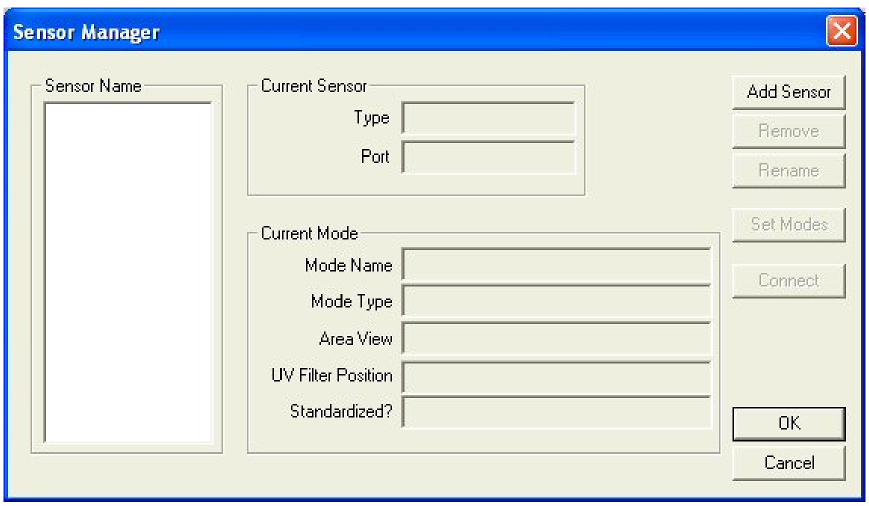
CHAPTER EIGHT

The Sensor Menu

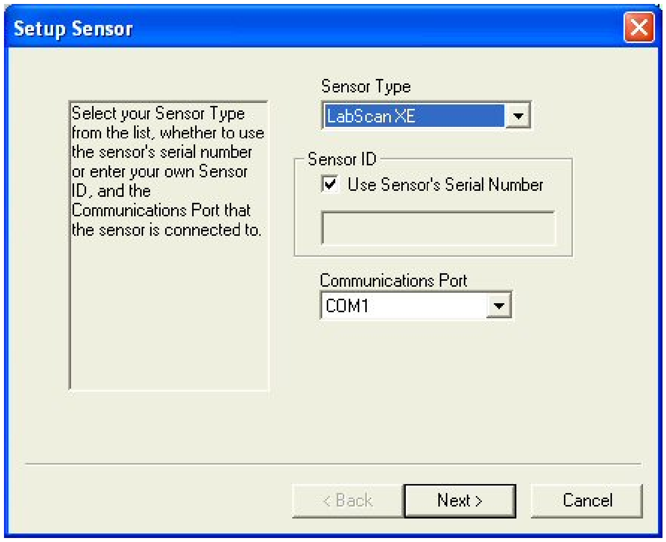
From the **Sensor** menu you can select and configure a new sensor, set its standardization modes, and standardize the sensor. You may also set the standardization interval for the instrument and calibrate the optional UV filter. The functions available through the **Sensor** menu are described in the remainder of this chapter.

Sensor/Install//Configure

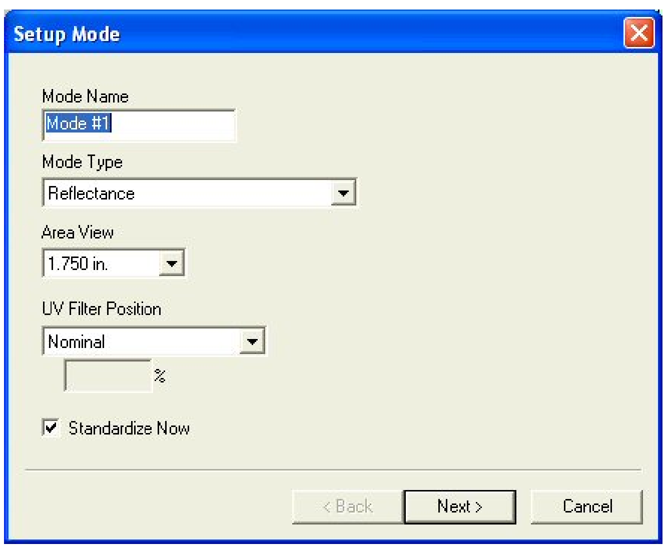
The **Install/Configure** command in the **Sensor** menu allows you to install a new sensor or change the configuration of an existing sensor. The Sensor Manager appears first.



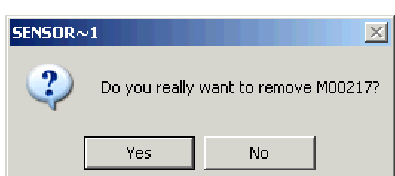
Click **Add Sensor** to install a new sensor. The Setup Sensor screen appears on which you can select your instrument model, name the sensor (using the sensor's serial number is recommended), and indicate the communications port where it will be installed. Click **Next** when these items are as desired.



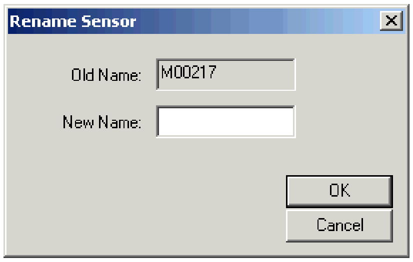
Next, you are prompted to configure a standardization mode for the sensor. Enter a name for the mode, and indicate the other mode parameters. Check the box next to Standardize Now if you would like standardization to proceed immediately upon completion of sensor configuration. Click **Next** or **Finish** to complete the installation. For instruments with more than one available standardization mode, you will receive a check box asking if you would like to set up additional modes. Do so if desired. Then you are either prompted through the standardization process (as described later in this chapter) or returned to the Sensor Manager screen.



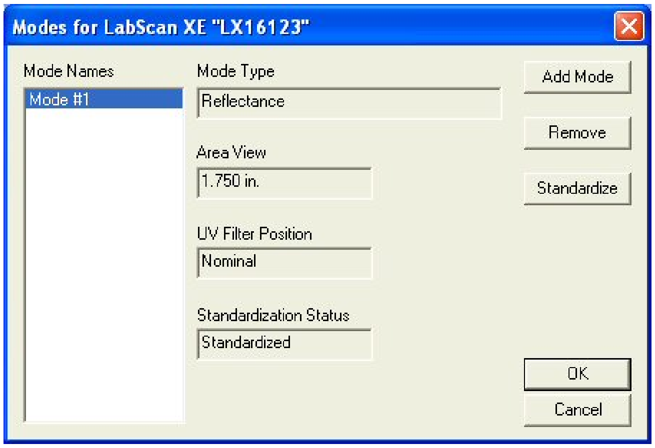
To delete a sensor, highlight it in the Sensor Name box and click **Remove**. Confirm that you really wish to remove the sensor by clicking **Yes**.



To rename a sensor, highlight it in the Sensor Name box and click **Rename**. Type the new name into the New Name box and click **OK** to implement the change.



To set the standardization modes for a sensor, highlight it in the Sensor Name box and click **Set Modes**.

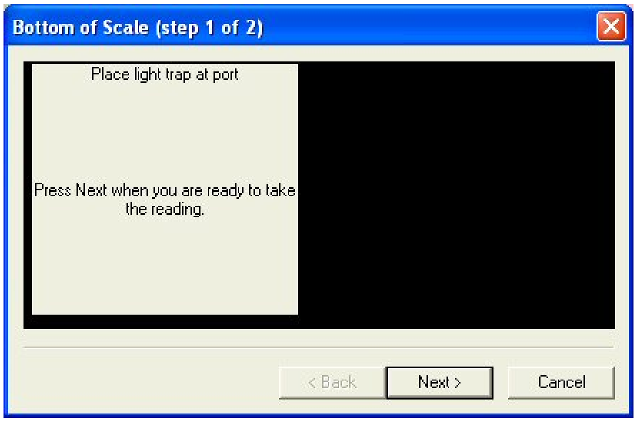


To connect to a different sensor than the one that is currently in use, first check your sensor cables to ensure that they are linking the desired new sensor to the computer. Then, highlight the desired new sensor name in the Sensor Name box and click **Connect**. The new sensor will then be in use.

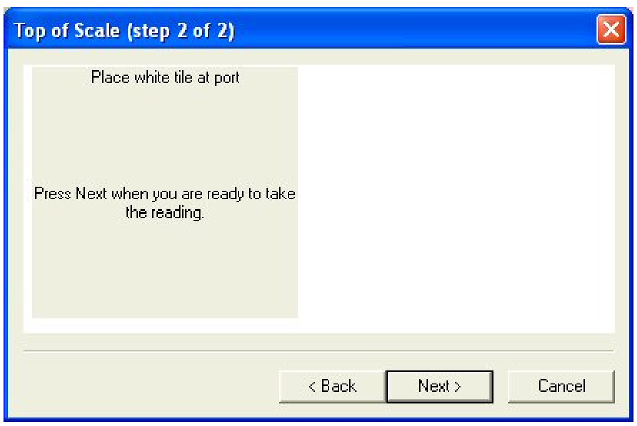
Sensor/Standardize

The **Standardize** command in the **Sensor** menu yields prompts that lead you through the standardization procedure for the standardization mode currently selected using the **Set Modes** command. The prompts will appear slightly differently depending on the instrument in use and the standardization mode. The keyboard shortcut for this command is **F4**.

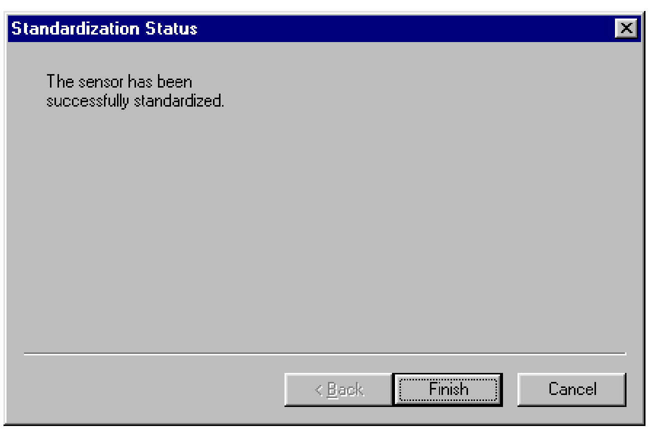
First, the bottom of scale must be set. Click **Next** when you are ready to read the zero.



Then, the top of scale must be set. Click **Next** when you are ready to read the standard or blank.



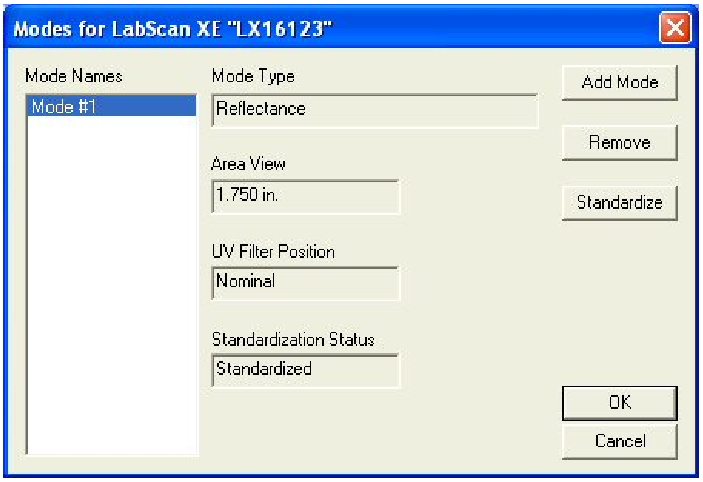
Click **Finish** when standardization is complete.



More instructions on instrument standardization are provided in Lessons 1 and 4 in Chapter 2.

Sensor/Set Modes

The **Set Modes** command in the **Sensor** menu allows you to configure standardization modes for the currently active sensor.



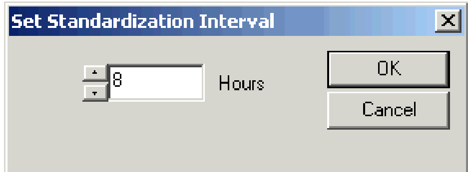
To add a new mode, click the **Add Mode** button.

To remove an already configured mode, highlight it in the Mode Names box and click **Remove**.

To standardize in a particular mode, highlight it in the Mode Names box and click **Standardize**. Follow the prompts to complete standardization.

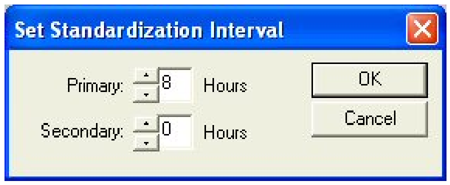
Sensor/Set Interval

The **Set Interval** command in the **Sensor** menu allows you to set the standardization interval for the currently active sensor. When that interval has elapsed, the software will prompt you to standardize before more readings can be made. The interval indicated here applies to EasyMatch QC as a whole, regardless of the job currently in use.



Note: A standardization interval of no longer than 8 hours is recommended.

If your installed sensor is a LabScan XE, you may also set the secondary standardization interval, which is the interval at which the secondary white tile "paddle" is automatically checked. Zero disables reading of this tile entirely.

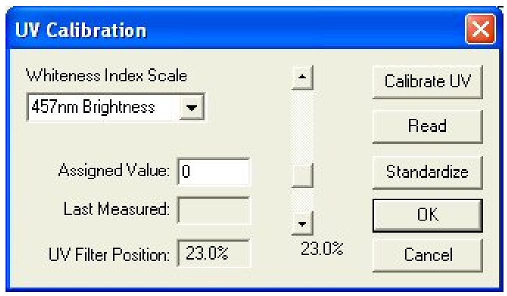


Sensor/UV Filter Calibration

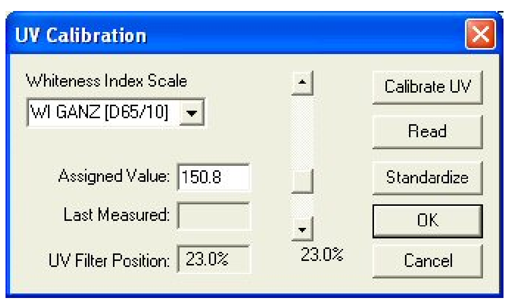
The **UV Filter Calibration** command in the **Sensor** menu appears only when the connected instrument is a ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, or UltraScan VIS with the UV control option installed. The instrument must also be standardized in a mode for which the UV Filter Position is indicated as "Calibrated."

Note: Before calibrating the UV filter of a ColorQuest XE, UltraScan XE, UltraScan PRO, or UltraScan VIS, standardize the instrument in the mode referenced on the label of the fluorescent standard. If the label does not specify a standardization mode, standardize in RSEX.

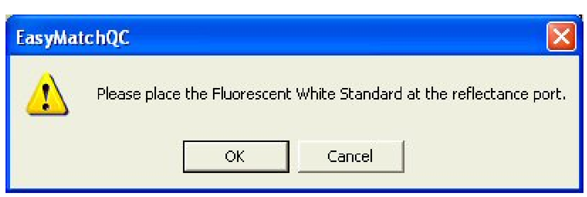
UV filter calibration should be performed weekly and also after lamp replacement. Once **UV Filter Calibration** is chosen from the **Sensor** menu, the following screen appears.



Enter the standard's assigned value into the appropriate box on the UV Calibration screen. This value has been assigned at the factory if you are using the HunterLab-supplied fluorescent standard. Also choose whether the value is for Brightness 457, Whiteness Index CIE (and the illuminant/observer combination), Whiteness Index Ganz, or Z%. The scale used will be WI Ganz for a HunterLab standard.



Select **Calibrate UV** to automatically adjust the UV filter to the appropriate position after several readings of the fluorescent standard. First you are prompted to place the fluorescent standard.



Place the fluorescent standard at the instrument port. For the ColorQuest XE, UltraScan XE, UltraScan PRO, or UltraScan VIS, center spot 3 at the reflectance port. Use the dotted guides on the labeled side of the standard to properly center the standard under the sample clamp. Select **Read** to read the fluorescent standard with the UV filter in the position indicated at the bottom of the screen. If desired, the slider bar may be used to change the filter position between manual readings.

Click **Standardize** to initiate standardization. You will be returned to the UV Calibration screen after standardization is complete.

For the ColorQuest XE, UltraScan XE, UltraScan PRO, and UltraScan VIS, measure both spot 3 and spot 4 of the fluorescent standard every six months. Compare the results. If spot 3 has faded beyond tolerable limits for your application, use spot 4 for UV filter calibration from this point on and order a new fluorescent standard (HL#A02-1011-126 [calibrated] for ColorQuest XE, UltraScan PRO, and UltraScan VIS, A02-1008-385 [calibrated] for UltraScan XE, or A04-1008-388 [uncalibrated]).

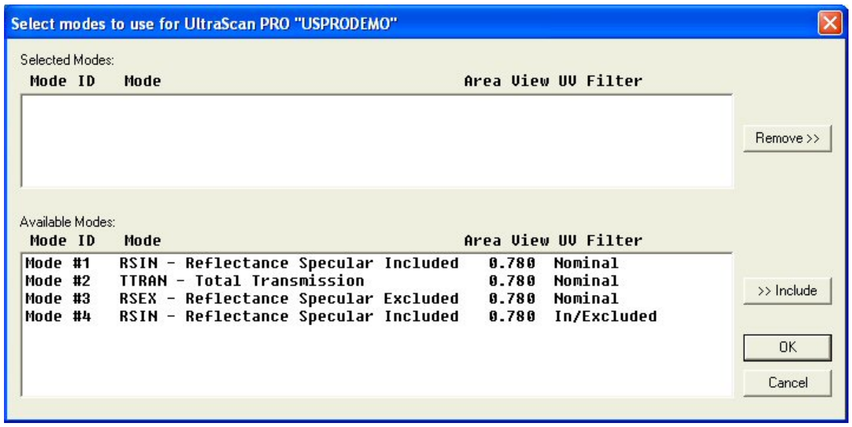
Note: If you choose to employ the "calibrated" filter position, this position should be employed for all routine measurements using this instrument.

Note: If you calibrated the UV filter with an open port and then you wish to use a cover glass, you must recalibrate the UV filter with the cover glass in place.

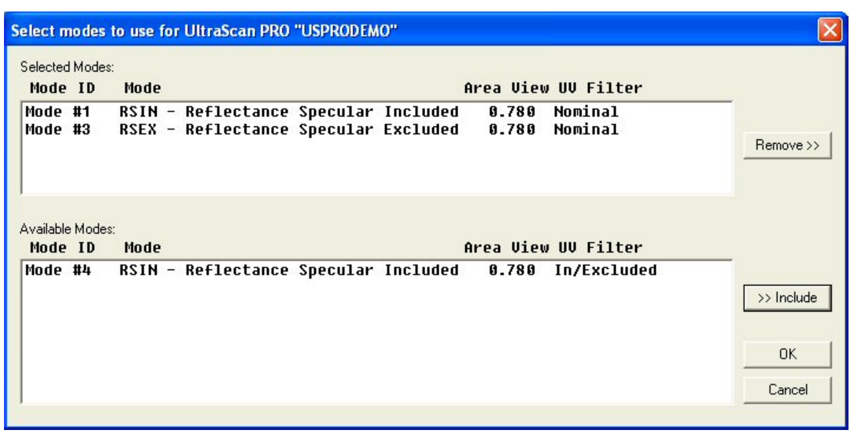
Sensor/Configure Multi Mode

The **Configure Multi Mode** command in the **Sensor** menu appears only when the connected instrument is a ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, or UltraScan VIS. This command is use to set up the process by which the instrument can standardize and read in two separate but similar modes when the standardization and read commands, respectively, are given.

The following screen first appears that allows you to indicate how you would like the multimode readings to be performed.



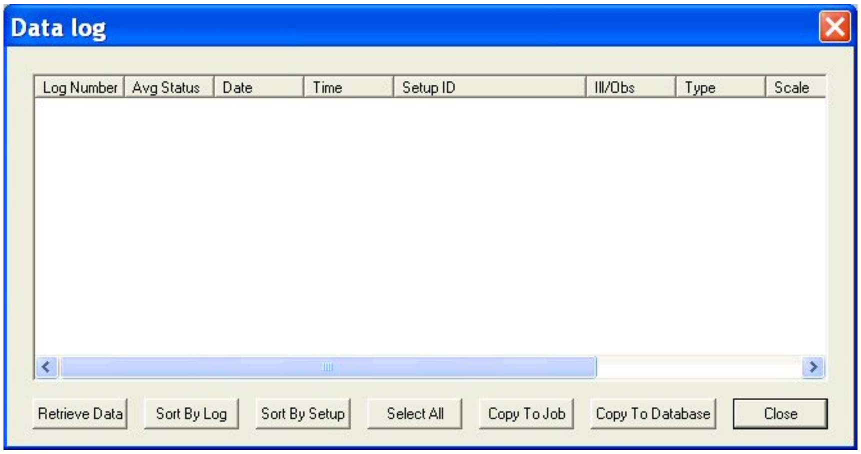
When this screen first opens, all of the standardization modes you have configured for your instrument (using **Sensor**/**Set Modes**) are listed in the Available Modes box. Click on the first mode you wish to use and then click the **Include** button to move the mode from the Available Modes box to the Selected Modes box. Only modes that are similar enough to the already-selected mode that no user intervention is required for the dual measurements will remain available. Select the second desired mode and click **Include** again to include it. Click **OK**. Then, when the **Read Method** in the **Options** menu is set as Multiple Read Mode, the instrument will be standardized in the two modes when you initiate standardization and will read in the two modes when you initiate readings. The multiple readings are placed in the job as separate measurements.



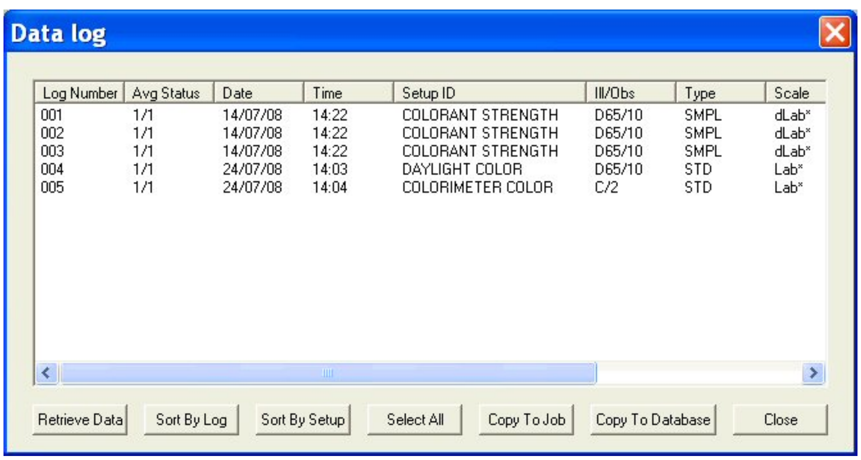
Sensor/Import Logged Reads

The **Import Logged Reads** command in the **Sensor** menu appears only when the connected instrument is a ColorFlex, MiniScan XE Plus, or MiniScan EZ. There must be items saved to the instrument datalog in order to use this command.

The Data log screen appears first.



Click **Retrieve Data** to copy all of the measurements stored in the instrument's datalog to the Data log screen.



Once the measurements are shown, the remainder of the buttons at the bottom of the screen become active and serve the following functions:

Sort By Log: Causes the measurements shown in the Data log window to be sorted by their instrument datalog ID numbers for easier viewing.

Sort by Setup: Causes the measurements shown in the Data log window to be sorted by their instrument setup numbers for easier viewing.

Select All: Selects (highlights) all of the measurements shown on the Data log screen so that the **Copy to Job** or **Copy to Database** command may be applied to all of them at once. (The alternative to **Select All** is to use the Windows convention of clicking on a single item to select it, **Ctrl** + clicking on multiple items to select them, or **Shift** + clicking on the first and last of a list of items to select all the items between.

Copy to Job: Places the measurements that are currently selected into the active job. Standards are automatically placed in the job as standards. You are prompted to indicate the standard under which samples should be saved.

Copy to Database: Places the measurements that are currently selected into the database. Standards are saved as standards and samples as samples, and the datalog ID number is used as the item ID.

The measurements copied to the job or EasyMatch QC database are NOT deleted from the instrument's datalog. If you wish to delete them, you must do so manually though the instrument firmware.

This feature is described in more detail in Lesson 7 of Chapter 2.

Sensor/Configure Setups

The **Configure Setups** command in the **Sensor** menu appears only when the connected instrument is a ColorFlex, MiniScan XE Plus, or MiniScan EZ. When you select it, the Setup Groups window appears where you can choose to create, edit, or delete setup groups and upload, modify, and download individual setups.

Upload

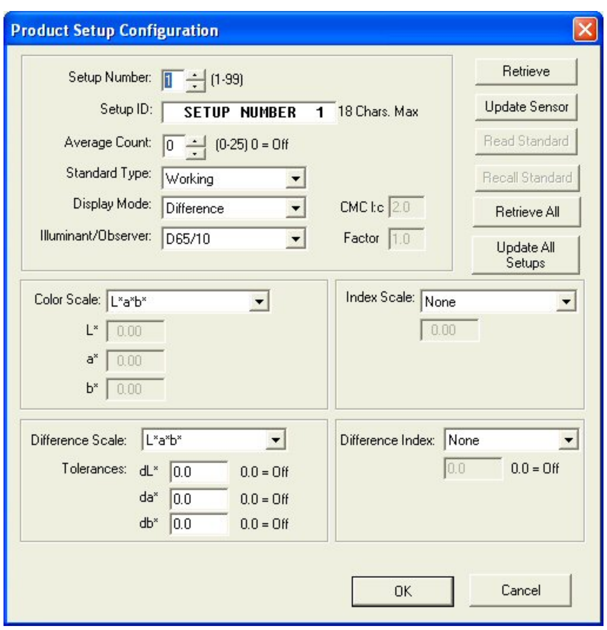
When you click **Upload**, all of the setups stored in the instrument are brought into EasyMatch QC. These setups can then be edited, if desired. The setups can also be saved as a setup group by typing a name into the white box or selecting a name from the drop-down list and clicking **Save**. Later, you can select the desired group and click **Get** to retrieve that saved group of setups or **Delete** to delete the group of setups.

Download

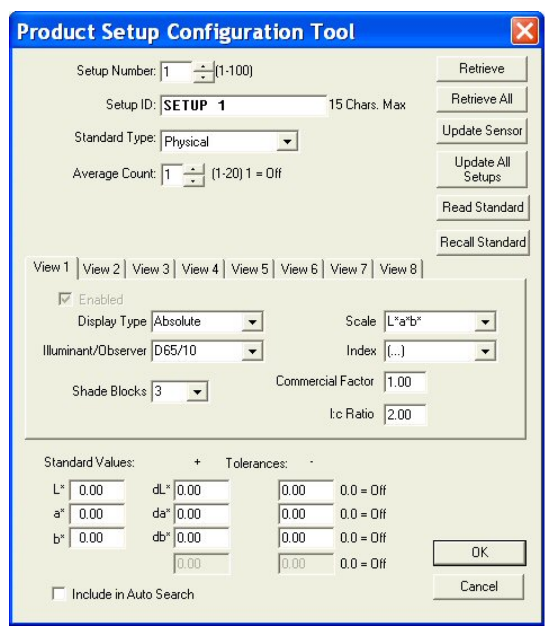
When you click **Download**, the setups in the current EasyMatch QC setup group are sent back to the instrument.

Edit

When you click Edit, the Product Setup Configuration screen appears.



ColorFlex and MiniScan XE Plus



MiniScan EZ

Use the scroll bar next to Setup Number or type a setup number into the box to choose a setup with which to work. If you wish to begin working with the version of the setup that is already resident in your instrument, click **Retrieve**. If you wish to work with the version of the setup that is shown on-screen, do not click **Retrieve**.

Alter the setup parameters as desired. The parameters and selections available are the same as those configured through your instrument firmware. If you are using a physical standard, you may click the **Read Standard** button to read the standard to be saved with the setup using your instrument or **Recall Standard** to recall a standard from your EasyMatch QC database to be saved with the setup.

When all parameters are as desired for this setup, click **Update Sensor** to send the setup to your instrument. You may retrieve all the setups from the instrument at once using the **Retrieve All** button or send all the setups back to the instrument at once using the **Update All** Setups button.

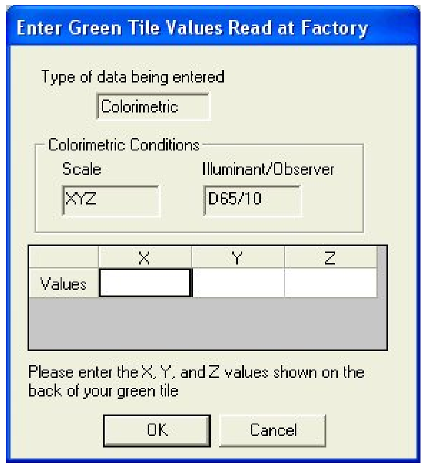
This feature is described in more detail in Lesson 7 of Chapter 2.

Sensor/Diagnostics

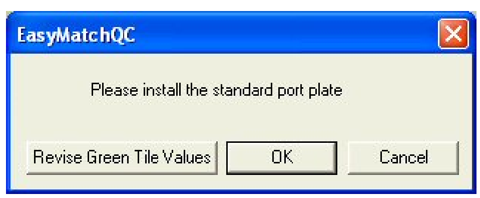
The **Diagnostics** command in the **Sensor** menu opens to a submenu allowing access to the various diagnostic tests available to verify performance of your instrument. Those tests are described below.

Green Tile Test (available for all instruments except ColorQuest XT and MiniScan XE Plus)

When **Green Tile Test** is selected from the **Diagnostics** submenu, a special job is opened in EasyMatch QC and, if this is the first time you have run the green tile test for this instrument, the following screen will be shown.

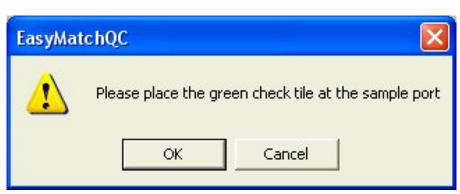


As prompted, enter the values read at factory for your green tile in XYZ. These values can be found on the back of the green diagnostics tile. Once all three numbers have been entered, click **OK**. A standard called "Green Tile Values Read at Factory" will be created in a Green Tile Test Job. The following prompt then appears.



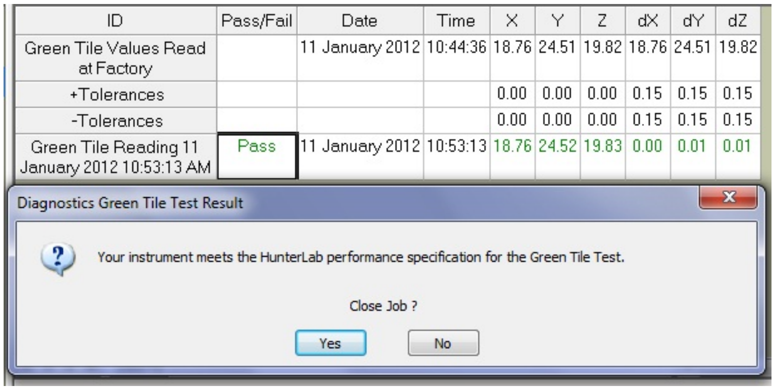
As instructed, make sure that the standard port plate for your instrument is currently installed. This will generally be the port insert with the largest opening that is not covered by glass. Click **OK** when this port plate is installed. If you need to adjust your green tile values, click **Revise Green Tile Values** before clicking **OK**.

Follow the on-screen prompts to perform a normal standardization in reflectance/RSIN mode. When standardization is complete, the following prompt will be shown.



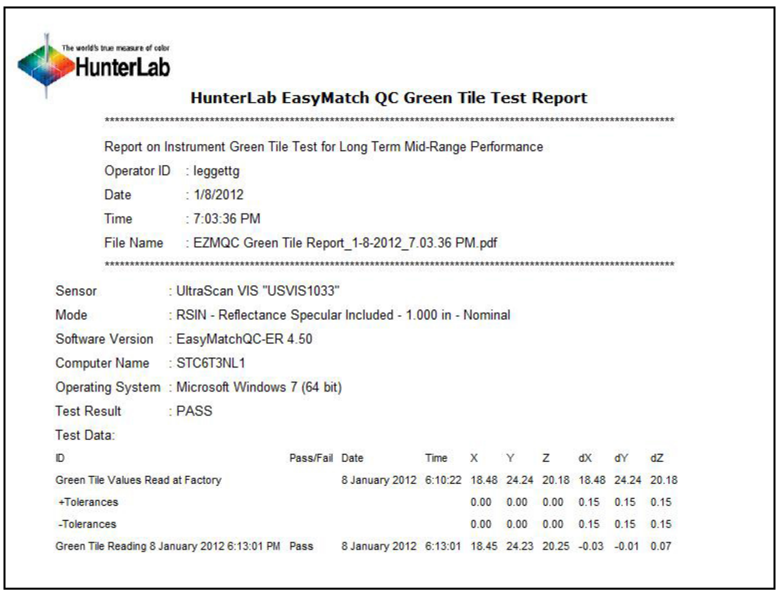
Center the green tile over the sample port/reflectance port with the colored side facing the instrument. Click **OK**.

The green tile will be read and the measurement added to the green tile check job. Its pass/fail status will also be shown. Should this test "Fail", a different message will appear suggesting actions to take.



ID	Pass/Fail	Date	Time	X	Y	Z	dX	dY	dZ
Green Tile Values Read at Factory		11 January 2012	10:44:36	18.76	24.51	19.82	18.76	24.51	19.82
+Tolerances				0.00	0.00	0.00	0.15	0.15	0.15
-Tolerances				0.00	0.00	0.00	0.15	0.15	0.15
Green Tile Reading 11 January 2012 10:53:13 AM	Pass	11 January 2012	10:53:13	18.76	24.52	19.83	0.00	0.01	0.01

Click **Yes** to close the Green Tile Job. The following pdf report will appear documenting the results of the test. As an option, this report can be printed as a hardcopy for your records. In addition, this **Green Tile Report** is automatically saved in c:\HunterLab\EasyMatchQC-ER Client\Reports with a unique data/time stamp for future reference.



The world's true measure of color
HunterLab

HunterLab EasyMatch QC Green Tile Test Report

Report on Instrument Green Tile Test for Long Term Mid-Range Performance
Operator ID : leggettg
Date : 1/8/2012
Time : 7:03:36 PM
File Name : EZMQC Green Tile Report_1-8-2012_7.03.36 PM.pdf

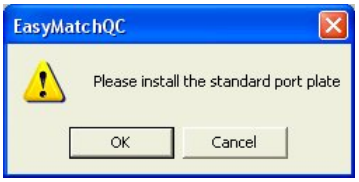
Sensor : UltraScan VIS "USVIS1033"
Mode : RSIN - Reflectance Specular Included - 1.000 in - Nominal
Software Version : EasyMatchQC-ER 4.50
Computer Name : STC6T3NL1
Operating System : Microsoft Windows 7 (64 bit)
Test Result : PASS
Test Data:

ID	Pass/Fail	Date	Time	X	Y	Z	dX	dY	dZ
Green Tile Values Read at Factory		8 January 2012	6:10:22	18.48	24.24	20.18	18.48	24.24	20.18
+Tolerances				0.00	0.00	0.00	0.15	0.15	0.15
-Tolerances				0.00	0.00	0.00	0.15	0.15	0.15
Green Tile Reading 8 January 2012 6:13:01 PM	Pass	8 January 2012	6:13:01	18.45	24.23	20.25	-0.03	-0.01	0.07

File/Exit to close the report and finish the test.

Repeatability Test (available for all instruments except ColorQuest XT)

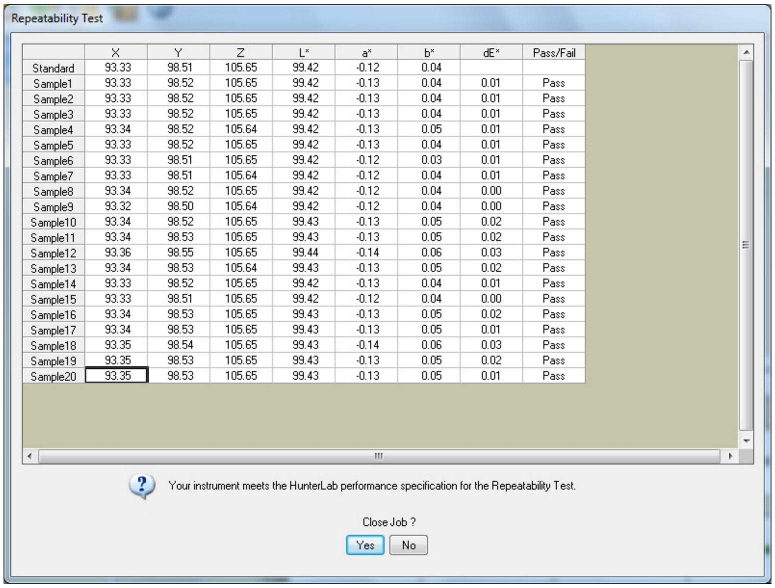
When **Repeatability Test** is selected from the **Diagnostics** submenu, a special job is opened in EasyMatch QC and the following prompt is shown.



As instructed, make sure that the standard port plate for your instrument is currently installed. This will generally be the port insert with the largest opening that is not covered by glass. Click **OK** when this port plate is installed.

Follow the on-screen prompts to perform a normal standardization in reflectance/RSIN mode. When standardization is complete, the following prompt will be shown.

Center the white calibrated tile over the sample port/reflectance port with the white side facing the instrument. Click **OK**. The Repeatability Test screen appears.



	X	Y	Z	L*	a*	b*	dE*	Pass/Fail
Standard	93.33	98.51	105.65	99.42	-0.12	0.04		
Sample1	93.33	98.52	105.65	99.42	-0.13	0.04	0.01	Pass
Sample2	93.33	98.52	105.65	99.42	-0.13	0.04	0.01	Pass
Sample3	93.33	98.52	105.65	99.42	-0.13	0.04	0.01	Pass
Sample4	93.34	98.52	105.64	99.42	-0.13	0.05	0.01	Pass
Sample5	93.33	98.52	105.65	99.42	-0.13	0.04	0.01	Pass
Sample6	93.33	98.51	105.65	99.42	-0.12	0.03	0.01	Pass
Sample7	93.33	98.51	105.64	99.42	-0.12	0.04	0.01	Pass
Sample8	93.34	98.52	105.65	99.42	-0.12	0.04	0.00	Pass
Sample9	93.32	98.50	105.64	99.42	-0.12	0.04	0.00	Pass
Sample10	93.34	98.52	105.65	99.43	-0.13	0.05	0.02	Pass
Sample11	93.34	98.53	105.65	99.43	-0.13	0.05	0.02	Pass
Sample12	93.36	98.55	105.65	99.44	-0.14	0.06	0.03	Pass
Sample13	93.34	98.53	105.64	99.43	-0.13	0.05	0.02	Pass
Sample14	93.33	98.52	105.65	99.42	-0.13	0.04	0.01	Pass
Sample15	93.33	98.51	105.65	99.42	-0.12	0.04	0.00	Pass
Sample16	93.34	98.53	105.65	99.43	-0.13	0.05	0.02	Pass
Sample17	93.34	98.53	105.65	99.43	-0.13	0.05	0.01	Pass
Sample18	93.35	98.54	105.65	99.43	-0.14	0.06	0.03	Pass
Sample19	93.35	98.53	105.65	99.43	-0.13	0.05	0.02	Pass
Sample20	93.35	98.53	105.65	99.43	-0.13	0.05	0.01	Pass

The white tile is read as a standard and then twenty times as a sample. The color values for each reading are displayed on the Repeatability Test screen as they are made. The pass/fail result for each reading is also shown. Once all of the readings have been made, you are provided with instructions concerning what you should do if your instrument fails the repeatability test. Click **Yes** if you wish to save the test data to the job or **No** if you wish the data to be discarded. The pass/fail tolerances for each instrument are listed below.

ColorFlex: Pass if dE* for the average reading is less than or equal to 0.04 else fail.

ColorFlex EZ: Pass if dE* is less than or equal to 0.05 else fail.

ColorQuest XE: Pass if dE* is less than or equal to 0.03 else fail.

ColorQuest II Sphere: Pass if dX, dY, and dZ are less than or equal to 0.02 else fail.

ColorQuest 45/0 LAV: Pass if dX, dY, and dZ are less than or equal to 0.02 else fail.

LabScan XE: Pass if dE* is less than or equal to 0.09 else fail.

MiniScan XE Plus: Pass if dX, dY, and dZ are less than or equal to 0.18 else fail.

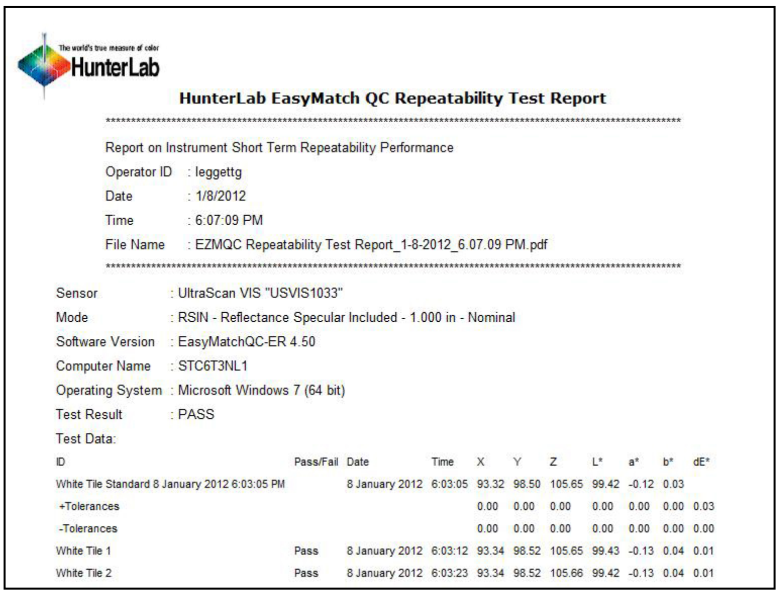
MiniScan EZ: Pass if dE* is less than or equal to 0.05 else fail.

UltraScan XE: Pass if dL*, da*, and db* are less than or equal to 0.02 else fail.

UltraScan PRO: Pass if dE* is less than or equal to 0.03 else fail.

UltraScan VIS: Pass if dE* is less than or equal to 0.03 else fail.

Click **Yes** to close the Repeatability Job. The following pdf report will appear documenting the results of the test. As an option, this report can be printed as a hardcopy for your records. This **Repeatability Test Report** is automatically saved in c:\HunterLab\EasyMatchQC-ER Client\Reports with a unique data/time stamp for future reference.



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HunterLab

HunterLab EasyMatch QC Repeatability Test Report

Report on Instrument Short Term Repeatability Performance

Operator ID : leggettg
Date : 1/8/2012
Time : 6:07:09 PM
File Name : EZMQC Repeatability Test Report_1-8-2012_6.07.09 PM.pdf

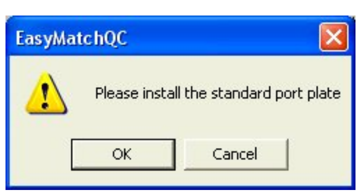
Sensor : UltraScan VIS "USVIS1033"
Mode : RSIN - Reflectance Specular Included - 1.000 in - Nominal
Software Version : EasyMatchQC-ER 4.50
Computer Name : STC6T3NL1
Operating System : Microsoft Windows 7 (64 bit)
Test Result : PASS
Test Data:

ID	Pass/Fail	Date	Time	X	Y	Z	L*	a*	b*	dE*
White Tile Standard 8 January 2012 6:03:05 PM		8 January 2012	6:03:05	93.32	98.50	105.65	99.42	-0.12	0.03	
+Tolerances				0.00	0.00	0.00	0.00	0.00	0.00	0.03
-Tolerances				0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Tile 1	Pass	8 January 2012	6:03:12	93.34	98.52	105.65	99.43	-0.13	0.04	0.01
White Tile 2	Pass	8 January 2012	6:03:23	93.34	98.52	105.66	99.42	-0.13	0.04	0.01

File/Exit to close the report and finish the test

Didymium Filter Test (available for ColorQuest XE, ColorQuest XT, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

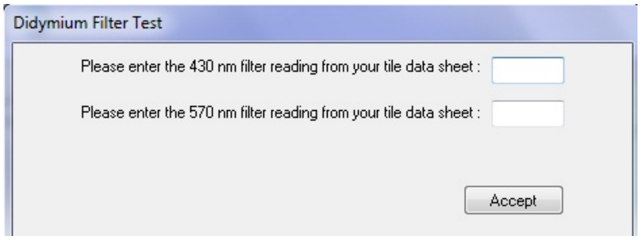
When **Didymium Filter Test** is selected from the **Diagnostics** submenu, a special job is opened in EasyMatch QC and the following prompt is shown.



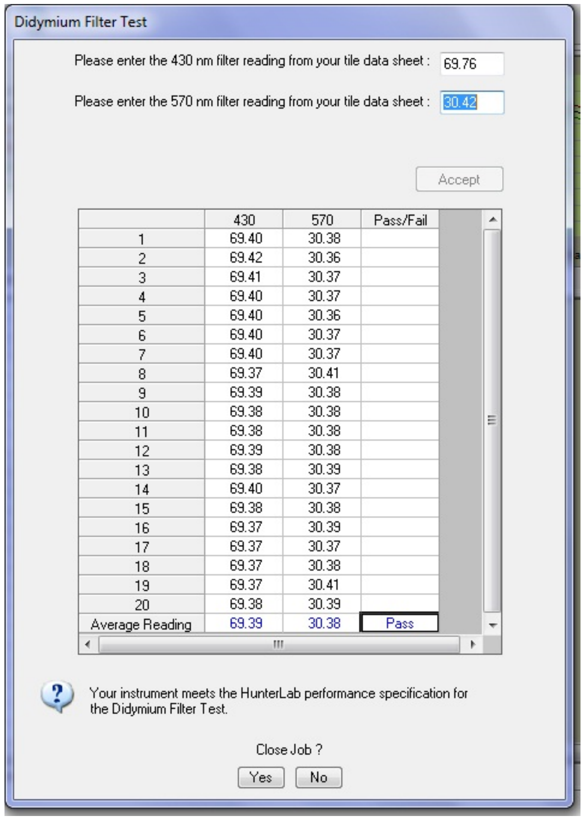
As instructed, make sure that the standard port plate for your instrument is currently installed. This will generally be the port insert with the largest opening that is not covered by glass. Click **OK** when this port plate is installed.

Follow the on-screen prompts to perform a normal standardization in RTRAN mode. When standardization is complete, the following prompt will be shown.

Screw the didymium filter, in its threaded tune, into the matching threads at the lens. Shut the transmission compartment door. Click **OK** when you have done so. The Didymium Filter Test screen appears.



As instructed, enter the 430 nm and 570 nm transmission values from the Didymium Filter area of your tile data sheet. For an UltraScan PRO, also enter the 820 nm reading. Click **Accept** to enter these values. (Click **Accept** on future instances of the test to acknowledge the correct values). Twenty readings of the didymium filter will be made and then averaged.

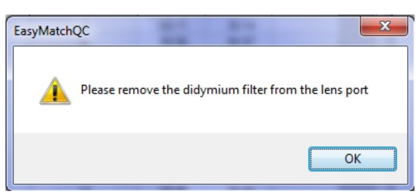


	430	570	Pass/Fail
1	69.40	30.38	
2	69.42	30.36	
3	69.41	30.37	
4	69.40	30.37	
5	69.40	30.36	
6	69.40	30.37	
7	69.40	30.37	
8	69.37	30.41	
9	69.39	30.38	
10	69.38	30.38	
11	69.38	30.38	
12	69.39	30.38	
13	69.38	30.39	
14	69.40	30.37	
15	69.38	30.38	
16	69.37	30.39	
17	69.37	30.37	
18	69.37	30.38	
19	69.37	30.41	
20	69.38	30.39	
Average Reading	69.39	30.38	Pass

A pass/fail assessment is provided for the averaged reading along with instructions concerning what to do if your instrument failed the test. Click **Yes** if you wish to save the test data to the job or **No** if you wish the data to be discarded. The pass/fail tolerances for each instrument are listed below.

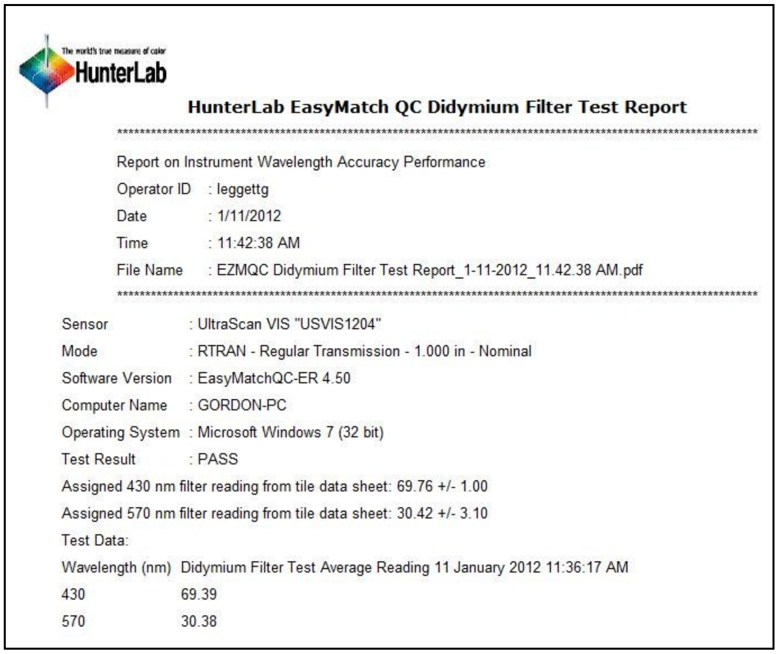
> ColorQuest XE, ColorQuest XT, UltraScan XE, and UltraScan VIS: Pass if the 430 nm average reading differs from the entered 430 nm value by no more than 1.00 %T and the 570 nm average reading differs from the entered 570 nm value by no more than 3.10 %T else fail.
>
> UltraScan PRO: Pass if the 430 nm average reading differs from the entered 430 nm value by no more than 1.2 %T and the 570 nm average reading differs from the entered 570 nm value by no more than 4.5 %T and the 820 nm average reading differs from the entered 820 nm value by no more than 2.0 %T else fail.

The following prompt is given next.



Remove the didymium filter from the lens port and click **OK**.

Click **Yes** to close the Didymium Filter Job. The following pdf report will appear documenting the results of the test. As an option, this report can be printed as a hardcopy for your records. This Wavelength Accuracy Didymium Filter Report is automatically saved in c:\HunterLab\EasyMatchQC-ER Client\Reports with a unique data/time stamp for future reference.



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HunterLab

HunterLab EasyMatch QC Didymium Filter Test Report

Report on Instrument Wavelength Accuracy Performance

Operator ID : leggettg

Date : 1/11/2012

Time : 11:42:38 AM

File Name : EZMQC Didymium Filter Test Report_1-11-2012_11.42.38 AM.pdf

Sensor : UltraScan VIS "USVIS1204"

Mode : RTRAN - Regular Transmission - 1.000 in - Nominal

Software Version : EasyMatchQC-ER 4.50

Computer Name : GORDON-PC

Operating System : Microsoft Windows 7 (32 bit)

Test Result : PASS

Assigned 430 nm filter reading from tile data sheet: 69.76 +/- 1.00

Assigned 570 nm filter reading from tile data sheet: 30.42 +/- 3.10

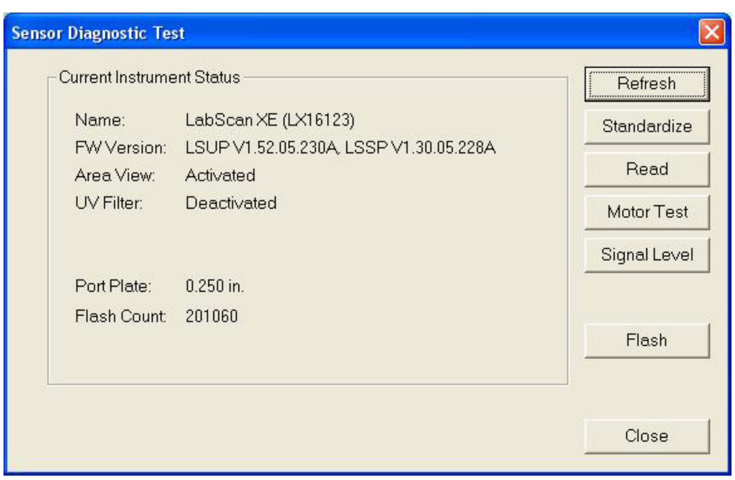
Test Data:

Wavelength (nm)	Didymium Filter Test Average Reading 11 January 2012 11:36:17 AM
430	69.39
570	30.38

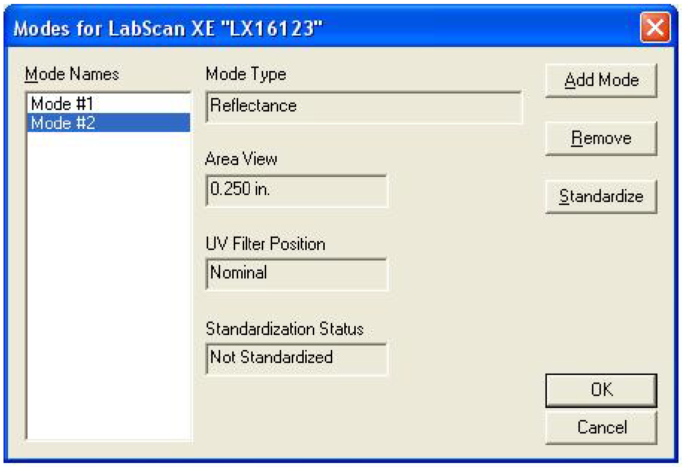
File/Exit to close the report and finish the test.

Hardware Checks (available for all instruments)

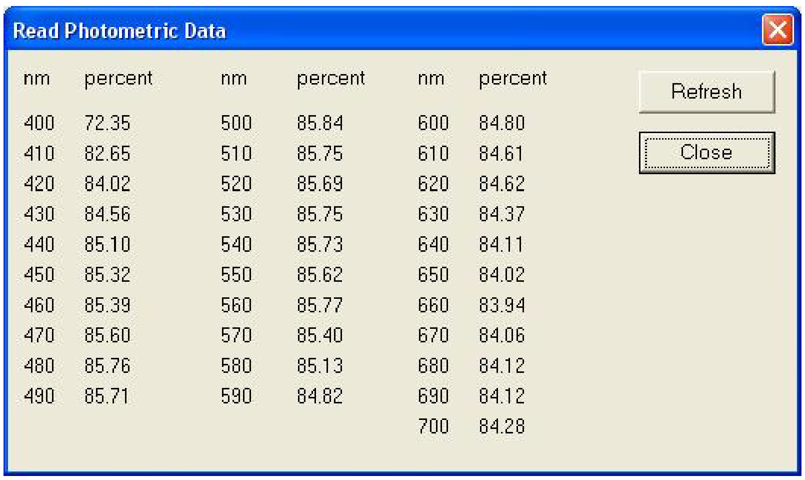
When **Hardware Checks** is selected from the **Diagnostics** submenu, a utility by which the various hardware components of your instrument may be checked is opened. Example screens for the LabScan XE are shown below. These screens will appear slightly differently for other instrument types.



The opening screen shows instrument status information for all instrument types. Click **Refresh** to update the information.

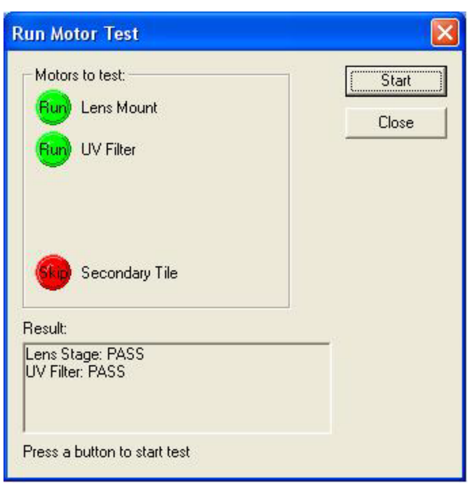


Click **Standardize** to select the standardization mode desired and standardize the instrument as usual.

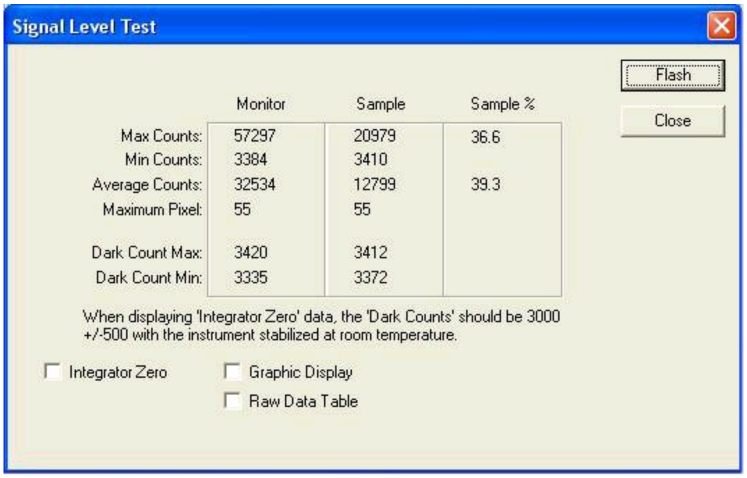


nm	percent	nm	percent	nm	percent
400	72.35	500	85.84	600	84.80
410	82.65	510	85.75	610	84.61
420	84.02	520	85.69	620	84.62
430	84.56	530	85.75	630	84.37
440	85.10	540	85.73	640	84.11
450	85.32	550	85.62	650	84.02
460	85.39	560	85.77	660	83.94
470	85.60	570	85.40	670	84.06
480	85.76	580	85.13	680	84.12
490	85.71	590	84.82	690	84.12
				700	84.28

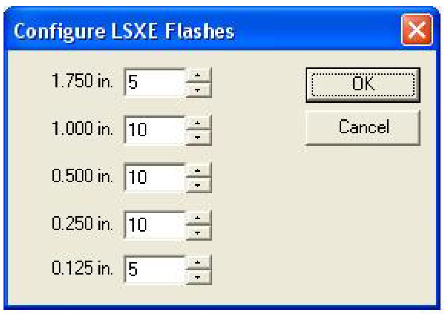
Click **Read** to show the spectral data for the sample that is currently at the sample port. Click **Refresh** to read again.



Click **Motor Test** to test the instrument motors. Click the button to the left of each test name to toggle between Run (perform the test) and Skip (do not perform the test), then click **Start** to begin the chosen test(s). These tests are not available for ColorFlex, ColorQuest XT, ColorQuest II, ColorQuest 45/0 LAV, MiniScan EZ, and MiniScan XE Plus, as there are no motors in these instruments to test. Results are shown at the bottom of the screen.



Click **Signal Level** and then click **Flash** to display raw signal level counts for the sample that is currently at the sample port. Check any of the available boxes to show the data a different way, such as in a graph.



Click **Flash** to alter the number of flashes per reading for each LabScan XE area of view. This screen applies only to the LabScan XE.

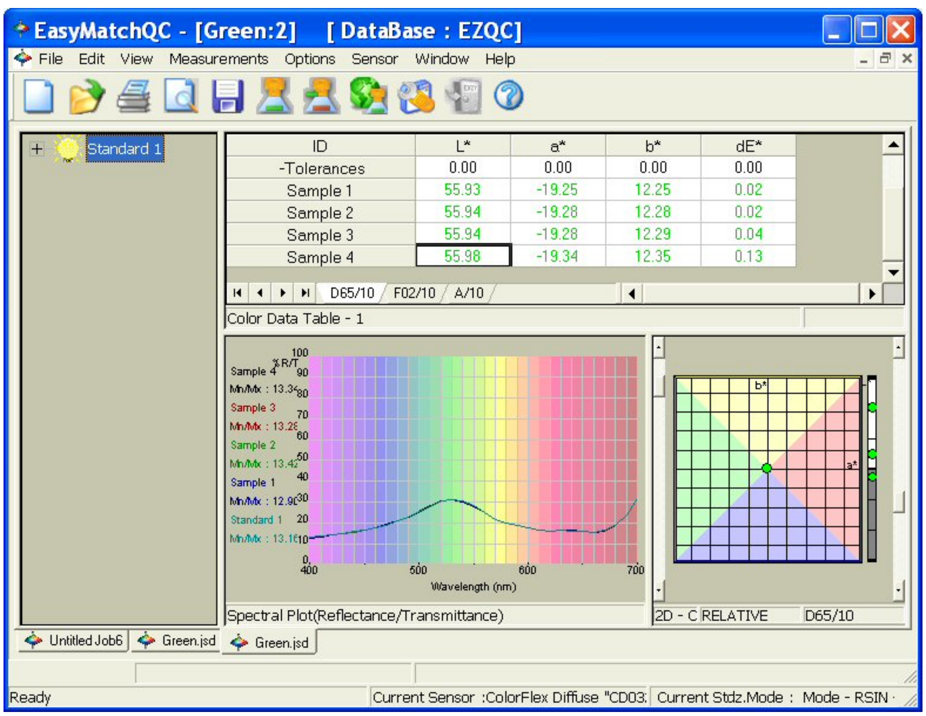
CHAPTER NINE

The Window Menu

From the **Window** menu you can arrange the data views on the screen, open a new window, or go to a specific job. The functions available through the **Window** menu are described in the remainder of this chapter.

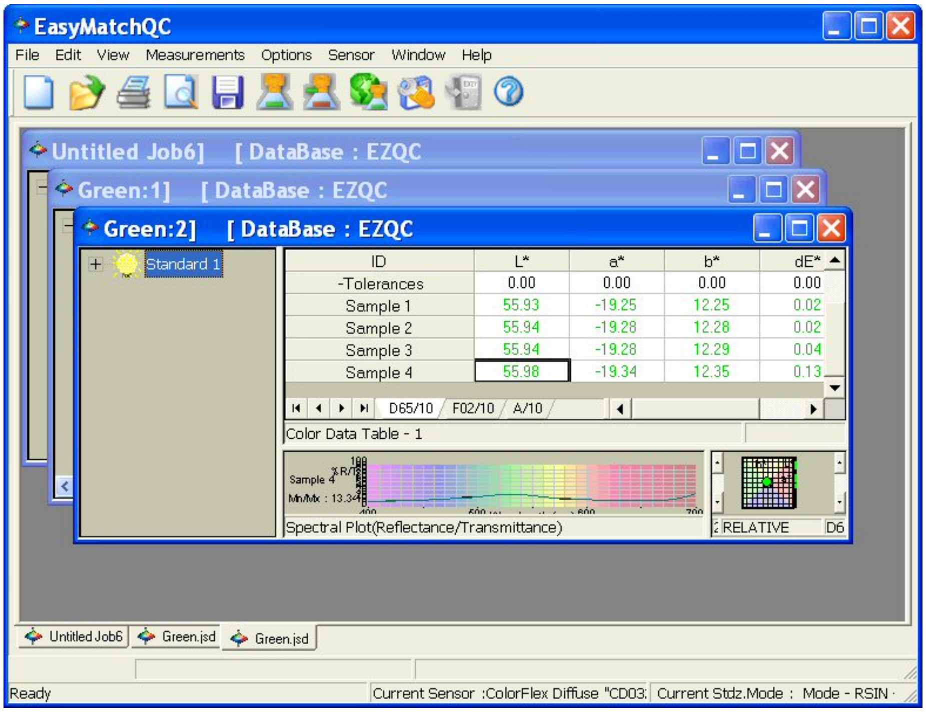
Window/New Window

The **New Window** command in the **Window** menu allows you to open a second window for the current job on your EasyMatch QC screen. This allows you to create additional displays for the job, if you wish, without running out of room on the screen.



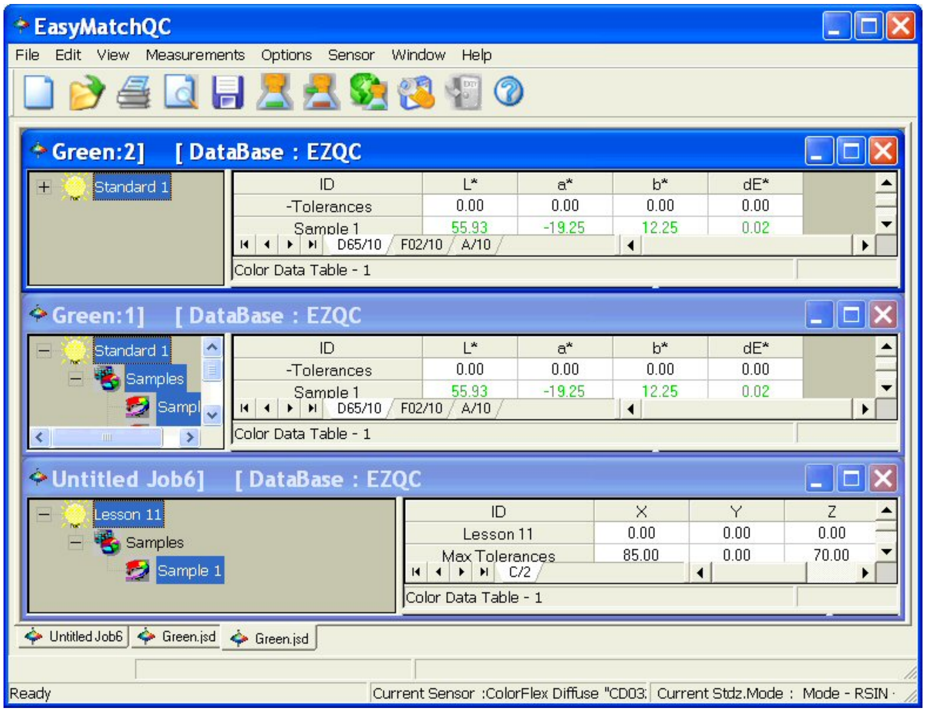
Window/Cascade

The **Cascade** command in the **Window** menu moves all of the current jobs so that they are cascaded one on top of the other and only the title bar of each job is visible. You may click on any of the title bars to show that job as the top job. Pressing **Ctrl** and **Tab** simultaneously toggles each job to the top in turn.



Window/Tile

The **Tile** command in the **Window** menu moves all of the current jobs so that they are displayed on the screen with one on top of the other. The sizes of the jobs are adjusted so that they all fit on the screen. The currently selected job is always placed in the upper portion of the screen area.



Window/List of Open Jobs

You can make any job active by selecting it from the **Window** menu. A check will appear next to that job in the **Window** menu, the title bar of the active job will be highlighted, and the job will come to the front.

CHAPTER TEN

The Help Menu

From the **Help** menu you can view the EasyMatch QC help file and information about your version of the program. The functions available through the **Help** menu are described in the remainder of this chapter.

Help/Help Topics

The **Help Topics** command in the **Help** menu opens the EasyMatch QC help file in which you can locate information on how to operate your instrument and software by searching for keywords, using the index, or using the table of contents. In order to use the help file, you must have a web browser (such as Internet Explorer or Netscape Navigator) installed on your computer. The keyboard shortcut for this command is **F1**.

> *Note: If you are running Windows XP with Service Pack 2 installed and are viewing the help file using Microsoft Internet Explorer, you will need to allow blocked content in order to view the help correctly. See the yellow bar at the top of the browser for instructions on how to do so.*

Help/About

The **About** command in the **Help** menu brings up the About EasyMatch QC Software box specifying the version of EasyMatch QC being run and giving copyright and contact information.

Help/HunterLab on the Web

The **HunterLab on the web** command in the **Help** menu opens your web browser and takes you to the HunterLab web site in case you need to get information on color measurement, instruments, or technical assistance.

Part III. Instruments

CHAPTER ELEVEN E

MiniScan® EZ

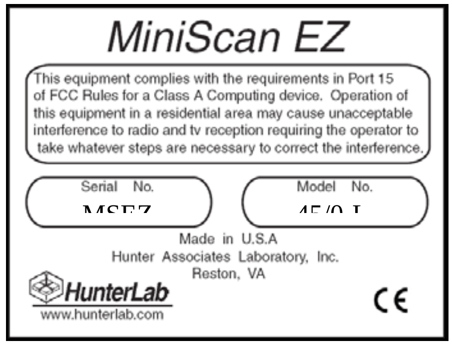
Notice: Use of this equipment in a manner not specified by the manufacturer may impair the protection afforded by the equipment.

Notice: Take care not to drop the MiniScan EZ. If it is dropped, have it evaluated for damage before operation.

The MiniScan EZ spectrophotometer is a versatile color measurement instrument that can be used on products of virtually any size, and in industries as diverse as paint and textiles. Because of its compact design and portability, MiniScan EZ can be used to measure objects that would be difficult to position at the measurement port of a larger color instrument normally found in a laboratory, and in locations other than a laboratory.

The instrument uses a xenon flash lamp to illuminate the sample. The light reflected from the sample is then separated into its component wavelengths through a dispersion grating. The relative intensities of the light at different wavelengths along the visible spectrum (400-700 nm) are then analyzed to produce numeric results indicative of the color of the sample. This is an objective means of quantifying what was once considered a subjected aspect of a sample's appearance—its color.

MiniScan EZ is available in four different models based on viewing area and geometry. The label on the bottom of the instrument provides this information, which is outlined below.



Model	Geometry	Viewing Area
MSEZ-4500L	45°/0°	Large
MSEZ-4500S	45°/0°	Small
MSEZ-4000L	Diffuse/8° (Sphere)	Large
MSEZ-4000S	Diffuse/8° (Sphere)	Small

The MiniScan EZ may be operated using the keypad and display on the instrument itself, and it may also be operated while connected to a computer running EasyMatch QC. Therefore, having purchased both a MiniScan EZ and EasyMatch QC, you have two sources of information on the instrument in addition to this User’s Manual: the MiniScan EZ User’s Guide, which describes stand-alone operation, and the EasyMatch QC help file, which describes operation of the MiniScan EZ using the software. Refer to those information sources as required.

MiniScan EZ Accessories

The following accessories are included with the MiniScan EZ system and can be found in the provided carrying case:

- Sample port cover - screws on over the sample port to protect the instrument's optics when it is not in use.
- Calibration cylinder - houses the NIST traceable white calibrated tile that is placed at the sample port during standardization to set the top of the scale, the black glass or light trap that is placed at the sample port during standardization to set the zero, and the green check tile that is used to assess long-term instrument performance during the green tile test.
- Rechargeable batteries - a set of 6 rechargeable AA batteries and a charger (with 110V plug and 220V adapter) are provided for continuing use of the MiniScan EZ.
- USB cable for connecting the MiniScan EZ to the computer.
- Certificate of traceability for the standard white tile.
- Tile data sheet - provides NIST-traceable calibrated values for the standard white tile and values read at factory for the green tile.
- MiniScan EZ User's Guide.
- Utility program and Diagnostics CD.

MiniScan EZ Options and Sample Devices

There are many options and devices available for positioning samples at the measurement port of the MiniScan EZ and for making the instrument easier to use. Any or all of the following options and sample devices may be purchased for use with your MiniScan EZ. HunterLab part numbers are included for your convenience in ordering.

- External Printer (HL#A13-1014-259),
- Keyboard (HL#A13-1014-294),
- Bar Code Scanner (HL#A13-1014-254),
- Standard-A to Mini-A USB Adapter (HL#A21-1013-859),
- 45/0 LAV Fiber Package Adapter (HL#C02-1002-030),
- Skein Holder (HL#02-7396-00),
- 45/0 LAV Nose Cone with Lower Glass Assembly (HL#A02-1002-129) or Nose Cone with Lower Polycarbonate Assembly (HL#B02-1009-550),
- 420-nm UV Filter Assembly (HL#A02-1009-954).

External Printer

The external thermal printer connects to the MiniScan EZ's USB port via Standard-A to Mini-A adapter (HL#A21-1013-859) and prints measurement data or product setup parameters on request. The communications cable supplied with the printer must be used to connect the printer to the MiniScan EZ. More information on the external printer is provided in its separate User's Manual.

The printer is automatically detected by the MiniScan EZ once connected.

Keyboard

The optional flexible keyboard connects to the MiniScan EZ's USB port via Standard-A to Mini-A adapter (A21-1013-859) to allow easy entry of any alphanumeric information (such as setup names) required.

The up, down, left, and right arrow keys on the keyboard correspond to the same buttons on the MiniScan EZ button pad. The Enter key on the keyboard emulates the center (Go) button on the MiniScan EZ's button pad. Numbers and letters may be typed on the keyboard as usual.

The keyboard is automatically detected by the MiniScan EZ once connected.

Bar Code Scanner

The optional bar code scanner connects to the MiniScan EZ's USB port via Standard-A to Mini-A adapter (HL#A21-1013-859) to allow scanning of a bar code for the ID tag of a reading after the reading is made.

The bar code reader is automatically detected by the MiniScan EZ once connected.

Standard-A to Mini-A USB Adapter

The optional Standard-A to Mini-A USB adapter allows USB devices—such as printers, keyboards, and the bar code scanner—that normally connect to Standard-A USB ports like those on computers, to connect to the MiniScan EZ's Mini-A USB port. It also allows the standard MiniScan EZ USB cable to be used to connect two MiniScan EZ instruments together.

45/0 LAV Fiber Package Adapter

This option provides a special nose cone assembly and three removable adapters for measuring 6-inch (152-mm), 10-inch (254-mm), and 12-inch (305-mm) cylindrical fiber or yarn package diameters. To use the assembly, snap the appropriate port adapter onto the nose cone of the MiniScan EZ. Position the port adapter over the cylindrical fiber or yarn package and proceed with measurements. Take care to position the MiniScan EZ so that it will not move during readings. Averaging is recommended when measuring fibers or yarns with large diameters.

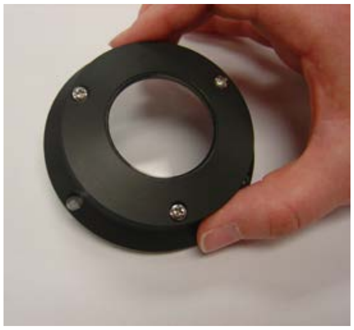
Skein Holder

The skein holder is available only for 45°/0° MiniScan EZ models.

This is a device for measuring yarn skeins. Wind the yarn around the skein holder in multiple taut layers until it is effectively opaque and is as flat as possible. Secure it in place with the detachable arms on the sides of the skein holder. Place the skein holder on a flat surface or the calibration tile holder and press the MiniScan EZ's sample port flat against the sample. Make several measurements of the skein, rotating the holder 90° between measurements and averaging the readings for the final result.

45/0 LAV Nose Cone with Lower Glass Assembly or Nose Cone with Lower Polycarbonate Assembly

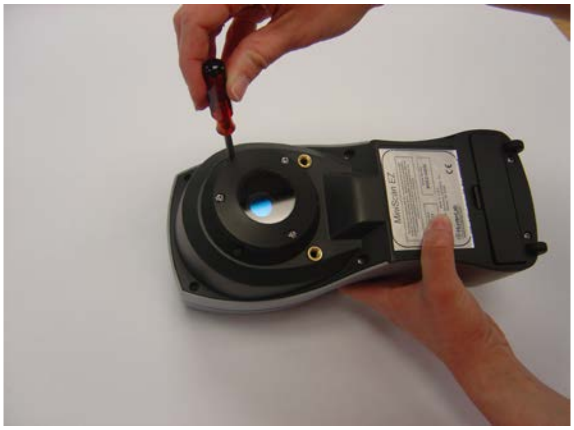
This option includes a special nose cone with a removable glass or plastic port cover assembly. The nose cone (black) portion is intended for permanent use on the instrument and should not be removed. Replacement cover assemblies (the lower portion of the device) are available from HunterLab. The assembly is sealed, but is not to be considered waterproof.



Glass nose cone

Replacement glass cover

The nose cone/port cover is generally in place when the MiniScan EZ is shipped from the factory. However, if installation is required, place the assembly over the instrument port and secure it using three Phillips-head screws. If the glass or plastic cover is to be replaced, remove the three machine screws with lock washers, replace the window and the O-ring, and secure it using the machine screws.



420-nm UV Filter Assembly

This option provides a 420-nm UV filter in a replaceable assembly for 45/0 LAV MiniScan EZs. The UV filter may be replaced or removed when necessary; however, the instrument is not to be used without the special nose cone in place.

> *Note: The special nose cone required for use of this part is not included, but may be purchased separately.*

To install the UV filter assembly, secure it to the instrument nose cone using three 4-40 pan-head screws with split-lock washers.

Replacement UV filter assemblies are available from HunterLab and are marked "UV" to differentiate them from cover glass assemblies. To replace the UV filter assembly, remove the screws and lift the assembly off the nose cone. Place the new UV filter assembly on the nose cone and replace the screws.

MiniScan EZ Installation

The MiniScan EZ is simple to set up and attach to your computer. Before operating the MiniScan EZ with EasyMatch QC, you need only install the batteries and connect the instrument to your computer. These steps are outlined below.

1. Unpack the carrying case and remove wrappings and cable ties. Inspect for damage and notify the carrier and HunterLab immediately if any is discovered. Save the packing materials in case it becomes necessary to return the instrument to the factory.

2. Open the battery compartment on the bottom of the MiniScan EZ.

3. Install the 6 AA batteries, observing the positive (+) and negative (-) polarity guides inside the battery compartment.

Notice: The MiniScan EZ can use six standard AA alkaline batteries or six rechargeable AA NiMH batteries. Do not mix battery types in the instrument. To recharge the NiMH batteries, remove them from the instrument and recharge them using the supplied charger.

4. Close the battery compartment.

5. Plug the hexagonal (Mini-A) end of the USB cable into the USB port on the MiniScan EZ.

6. Plug the flat end of the USB cable into the appropriate USB port on the computer. Windows' plug and play feature automatically finds and installs the device. Let it do so until the "Found new hardware" message disappears.

MiniScan EZ Standardization

The MiniScan EZ must be standardized on a regular basis to keep it operating properly.

Standardization on a MiniScan EZ model with 45°/0° geometry requires reading of the black glass and white tile that are contained in the calibration cylinder. Standardization on a diffuse/8° MiniScan EZ requires you to read both the light trap and the white tile in the calibration cylinder.

Standardization can be done through EasyMatch QC (by selecting **Standardize** from the **Sensor** menu or by clicking the **Standardize** button on the default toolbar) or directly through the MiniScan EZ firmware.

It is recommended that the instrument be standardized at least once every four hours. Then you may proceed with sample measurement.

MiniScan EZ Maintenance and Testing

The MiniScan EZ does require some maintenance. This chapter outlines the parts of the MiniScan EZ you must maintain in order for the instrument to function properly and tests that you may run to assess its performance.

Notice: The MiniScan EZ contains hazardous voltages and no user-replaceable parts. It should be disassembled only by HunterLab personnel.

Running the Repeatability Test

You may test the repeatability of your instrument as follows:

1. Turn the MiniScan EZ on and allow it to warm it up for 2 hours. Meanwhile, clean the white tile as described on the next page and allow the tile to return to room temperature.

2. Follow the instructions given in the Sensor Menu chapter, Diagnostics section to run the repeatability test that is built into EasyMatch QC.

Recharging/Replacing the Batteries

When the battery level indicator on the MiniScan EZ screen has decreased to outline only, you should replace the batteries with fresh or recharged ones.

Notice: The MiniScan EZ can use six standard AA alkaline batteries or six rechargeable AA NiMH batteries. Do not mix battery types in the instrument. To recharge the NiMH batteries, remove them from the instrument and recharge them using the supplied charger.

Replacing the Lamp

Lamp replacement requires a trained technician. Contact HunterLab Technical Support to arrange for lamp replacement. Please read "When You Need Assistance" prior to contacting HunterLab.

Cleaning the MiniScan EZ

Clean the outside surfaces of the MiniScan EZ using a soft cloth. Do not spray liquids directly on the instrument.

Maintaining the Instrument Standards

Before you standardize the MiniScan EZ each time, inspect the white tile and black glass (if included) for dust and fingerprints. If you have a light trap, inspect it for dust and scratches. Do the same for the green tile prior to running the green tile test. Keep the calibration cylinder in the carrying case when it is not being used. If a tile is lost or damaged, contact HunterLab as described in "When You Need Assistance" concerning replacement.

Clean the tiles and black glass using a soft nylon bristle brush and a solution of warm water and a laboratory grade detergent such as SPARKLEEN. Rinse the tiles in a stream of warm tap water. Blot them dry using a clean, non-optically brightened, lint-free paper towel.

Note: SPARKLEEN is manufactured by Fisher Scientific Co., Pittsburgh, PA 15219 and may be ordered from them using catalog number 4-320-4. One tablespoon of SPARKLEEN should be added to every gallon of water.

MiniScan EZ Specifications

The specifications and characteristics of your instrument are given in this section.

Note: Every attempt at accuracy is made, but specifications are subject to change without notice.

For best performance, your instrument should be placed where there is ample work space with medium or subdued illumination and no drafts. The operating conditions (temperature and humidity ranges) are given in the Operating Conditions section below.

Operating Conditions

MiniScan EZ can be stored in an area with a temperature range of -5°F to 150°F (-20°C to 65°C) for up to 3 weeks and can be operated under temperature conditions of 50°F to 104°F (10°C to 40°C). For specification-level performance, the recommended temperature range is 70-82°F (21-28°C). It may be operated under relative noncondensing humidity conditions of 10% to 90%. Do not leave MiniScan EZ in an area where temperature or humidity extremes are possible.

Physical Characteristics

Weight	2.25 lb (1 kg)
Dimensions	5.5" high x 4.3" wide x 10.5" long (14 cm x 11 cm x 26.7 cm)
Communications Interface	USB to computer or printer
RFI Compliance	FCC Class A (Commercial), IEC, or equivalent
Safety Compliance	UL, CSA, IEC, or equivalent

Conditions of Illumination and Viewing

Light Source	Pulsed xenon
Source UV content	Match to D65 with CIE rating of CC or better
Lamp Life	>1 million flashes
45°/0° Illumination	Circumferential, using a cylindrical mirror
Integrating Sphere (diffuse/8° instruments only)	2.5 inch (63.5 mm) diameter, coated with SpectraFlect
Detection	2-channel polychromator with 256-element scanned array (half for sample channel, half for monitor)
Port Diameters/View Diameters	**45°/0° LAV model:** 1.25" (31.8 mm)/1.0" (25 mm) **45°/0° SAV model:** 0.25" (6 mm)/0.20" (5 mm) **Diffuse/8° LAV model:** 1.0" (25 mm)/0.8" (20 mm) **Diffuse/8° SAV model:** 0.6" (14.3 mm)/0.3" (8 mm)

System Power

Power Input	Disposable or rechargeable AA batteries
Battery Life	>4,000 readings per charge

Instrument Performance

Spectral Data	Range: 400-700 nm Reporting Interval: 10 nm
Bandwidth at Half-height	10 nm
Wavelength Accuracy	≤0.75 nm
Photometric Range	1-150% reflectance
Photometric Resolution	0.01% reflectance
Measurement Speed (at 23°C)	≤1.5 seconds
Measurement Storage Capacity	800 spectral readings 100 product setups

Regulatory Notice

A copy of the Declaration of Conformity according to ISO/IEC Guide 22 and EN 45014 follows on the next page.

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hunter Associates Laboratory, Inc.

Manufacturer's Address: 11491 Sunset Hills Road
Reston, Virginia U.S.A. 20190

Declares that the Product:

Product Name: MiniScan EZ

Model: MSEZ-4500L, MSEZ-4500S, MSEZ-4000L, MSEZ-4000S

Conforms to the following Product Standards:

IEC 61326-1:2005 (CISPR 11:2003:A1:2004, EN 61000-4-2:1995, and EN 61000-4-3:2006 + A1:2008)

EN 61010-1:2001

Supplementary Information:

This product herewith complies with the requirements of the EMC Directive 2004/108/EC and Council Directive 98/34/EEC, and carries the CE mark accordingly.

(1) This product was tested using an IBM compatible computer.

European Contact: **Your local Hunter Associates Laboratory representative,**
or Christian Jansen
Griesbraeustrasse 11
82418 Murnau
Germany
Telephone: +49 (0) 8841 9464
Fax: +49 (0) 8841 99472

Sample Preparation and Presentation

The MiniScan EZ spectrophotometer is a versatile color measurement instrument that can be used on products of virtually any size, in industries as diverse as paint and textiles. Because of its compact design, it can be used to measure objects that would be difficult to position at the sample port of a larger color measurement instrument. However, careful attention to proper sample preparation and presentation is required for consistent and accurate color measurements.

It is important to select samples appropriately, use an established measurement method, and handle all samples in a consistent manner. The guidelines in this section will help you while taking measurements.

Selecting Samples

Choose samples that are representative of the material used. If samples are non-representative of the batch or are spoiled, damaged, or irregular, then the result may be biased. When choosing a sample, select randomly and examine the sample to avoid biased results. If your sampling procedure is adequate, another sample from the same batch should result in comparable measured values.

Preparing Samples

Prepare samples in exactly the same manner each time they are measured. Follow standard methods if they exist, such as ASTM or TAPPI methods.

Sample Presentation

Present the samples to the instrument in a standard, repeatable manner. Results obtained depend on the condition of the samples and their presentation. If you establish a method so that the same procedure is used each time specific samples or types of samples are measured, then you will have a valid basis for comparison of measured results. This also ensures repeatability of results when measuring the same sample. Make a checklist so that operators may simply check each step. The checklist will also help in the training of new operators.

There are a variety of techniques that can be used in handling various forms of objects and materials so that the most valid and repeatable measurement of their appearance results. For example, when measuring the color of a sample, such as fabric, that is translucence, the sample should be folded into multiple layers to make it appear more opaque. Other materials, such as liquids or semi-solids, might be read through the glass of a sample cup, which presents a flat surface to the instrument.

When taking readings, make sure that the MiniScan EZ sample port is flat against the sample surface. This may be difficult if the sample is curved or irregularly shaped. Look at the instrument from all angles to make sure the port makes as much contact as possible with the product. When measuring thin, soft materials (such as fabric or paper), place a hard, flat surface behind the product to ensure proper contact with the sample port and to ensure that it does not pillow into the

sample port. Average several readings when measuring samples that are textured, patterned, or irregular in color.

Examples of ways to measure several types of samples are given below.

Directional Samples

Directionality can be minimized by averaging several measurements with rotation of the sample between readings. Examination of the standard deviation displayed with the averaging function can guide you in selecting the appropriate number of readings to average.

Non-opaque Samples

Non-opaque samples must have consistent backings. A white uncalibrated tile is recommended. If the sample is such that it can be folded to give multiple layers, such as tissue or fabric, the number of layers for each sample should be noted.

Translucent Samples

Light trapped in a translucent sample can distort the color. The thickness of the sample presented should be chosen to maximize the haze or color difference and the sample should be backed, if possible, to eliminate the effects of ambient (room) light.

CHAPTER TWELVE

Instrument Replacement, Repair, Problems, and Questions

The following HunterLab policies are described in this chapter:

- Warranty
- Claims
- Returns/Service
- Technical Assistance.

Warranty

HunterLab warrants that all instruments it manufactures will be free from defects in material and workmanship under normal use and service. Our obligation under this warranty is limited to repairing or replacing any defective parts which our examination discloses to have been factory defective when returned to us by prepaid transportation. The time limit on this warranty is one year from date of shipment of new instruments and two months from the date of shipment of repaired instruments. The printer and computer are covered under the original manufacturer's warranty.

HunterLab warranty does not cover expendable items such as lamps, fuses, batteries, diskettes, etc. The warranty is void if the user has made unauthorized repairs, performed improper installation, or has incorrectly used the instrument.

An instrument registration card is shipped with major pieces of HunterLab equipment. It is important that you return this card promptly upon receipt of equipment. The registration card is kept on file with the HunterLab Service Department with complete information on the exact equipment purchased. Questions concerning operation, maintenance, or repair of your equipment directed to the Service Department can then be knowledgeably handled.

Shipping Claims

All materials are sold F.O.B. from Reston, Virginia (unless otherwise specified) and HunterLab responsibility ends upon delivery to the first carrier. All claims for loss or damage must be rendered by the consignee against the carrier within fifteen days of receipt of goods. A copy of this notice must also be forwarded to HunterLab within five days of its receipt.

Breakage or Damage

According to the contract terms and conditions of the carrier, the responsibility of the shipper ends at the time and place of shipment. The carrier then assumes full responsibility. Perform the following procedures if your instrument arrives broken or damaged.

Freight or Express

1. Notify your local carrier.
2. Hold the damaged goods with their container and packaging for inspection by the examining agent. Do not return any goods to HunterLab prior to inspection and authorization of the carrier.
3. File a claim against the carrier. Substantiate this claim with the examining agent's report. A certified copy of our invoice is available upon request. The original B/L is attached to our original invoice. If the shipment is prepaid, write for a receipted transportation bill.
4. Advise HunterLab regarding replacement.

Parcel Post Shipment

1. Notify HunterLab at once in writing, giving details of the loss or damage. This information is required for filing a claim.
2. Hold the damaged goods with their container and packaging for possible inspection by postal authorities.
3. Advise HunterLab regarding replacement.

United Parcel Service

1. Contact your local UPS office regarding damage and insurance claim. Each UPS office has a different method of handling these occurrences and yours will advise you of its procedures.
2. Retain the container and packaging.
3. Notify HunterLab at once for replacement.

Shortage

Perform the following procedure if your order appears to be missing items.

1. Check the packing list notations. The apparent shortage may be a back ordered item and may be marked as an intentional short-ship.
2. Re-inspect the container and packing material, particularly to locate smaller items.
3. Ascertain that the item was not removed by unauthorized personnel prior to complete unpacking and checking.
4. Notify HunterLab immediately of the shortage in writing.

Incorrect Shipment

Perform the following procedure if material received does not correspond with your order.

1. Notify HunterLab immediately, referencing order number and item.
2. Hold incorrect items until return shipping instructions are received.

Returns

A service request order (SRO) number is required before any items can be returned to HunterLab. Contact HunterLab's Order Processing Department to obtain an SRO for damaged or incorrect parts, or Technical Support to obtain an SRO to return an instrument for service.

Do not return any damaged or incorrect items to HunterLab until all shipping instructions are received.

> *Note: HunterLab must be notified within fifteen days or we cannot accept responsibility for damaged or incorrect items.*

HunterLab offers complete repair service for all instruments it manufactures. Call HunterLab for the service facility nearest your location. If your equipment is not functioning properly, contact HunterLab Technical Support for maintenance or repair instructions. Many times, this on-the-spot diagnosis is all that is required.

If repair is required, HunterLab offers two means of servicing. Instruments may be returned to a HunterLab service facility for repair or a HunterLab Service Department technician can come to your location to perform on-site repair. For schedule and terms for on-site repairs by trained service technicians, call HunterLab Technical Support. Please read "When You Need Assistance" prior to contacting HunterLab.

The customer is responsible for incoming and outgoing freight charges for instruments being returned to HunterLab for all repairs, including warranty repairs.

Packing and Shipping Instruments for Repair

Please regard the following instructions when packing your instrument to return it to HunterLab for repair. **Proper packing is crucial.** These instructions do not replace the recommended professional packaging for your instrument, but may assist in eliminating the need for a shipment claim due to faulty packaging. Purchasing freight insurance does not guarantee a successful damaged shipment claim if the carrier determines the instrument was not packaged properly.

- All instrument tiles, the didymium filter (if included), black glass or light trap, power supply, power cords, and cables for the instrument should be included in your shipment. **Your repair estimate will be delayed if the instrument tiles are shipped separately later.**

- Remove the sample clamp (if you have one) from the instrument before packing.

- Cover the measurement port. If applicable, also cover the transmission port and tape the transmission compartment door closed. **Do not use duct tape.** "Painter's tape" is preferred, as it will not leave residue on the instrument.

- Insert the instrument into an anti-static or plastic bag prior to placing it in the carton. The bag will aid in keeping packing material out of the instrument.

- Place the bag-wrapped instrument into a new carton which includes, at a minimum, **6 inches of packing material** (preferably foam) around the instrument. Styrofoam peanuts should not be used as packing material for instruments, as they can suspend items weighing only up to 5 pounds. Observe the information listed on the bottom of most cartons with regard to burst strength and gross weight limits. Single wall cardboard cartons should not be used. (A proper packing carton with packing material may be purchased from HunterLab, if desired.)

- Insure the shipment.
- Provide an itemized packing list of all contents of the shipment.
- Label the carton(s) as follows:

HunterLab
Attn: SRO #____________
11491 Sunset Hills Road
Reston, VA 20190
U.S.A.

When You Need Assistance

When you have a problem with an instrument or software or need technical advice concerning a specific application, you may contact HunterLab for assistance. In order to help us help you, please have the following information available prior to telephoning HunterLab.

> *Note: If at all possible, make your call within operational range of the instrument and computer so that troubleshooting steps can be performed as directed while on the phone.*

1. The type of sensor you need assistance with (i.e., ColorFlex 45/0, MiniScan XE Plus Diffuse SAV, or UltraScan XE).
2. The serial number of the instrument (usually found on a tag on the back or bottom of the sensor, or inside the transmission compartment).
3. The type of software you use to access the sensor output (EasyMatch QC), the version of the software (seen after choosing **About** from the **Help** menu), the operating system, and the brand and type of computer.
4. The specific nature of the problem, including the exact error message received or the number of units the sensor reads "off" from the standard tiles.
5. The steps performed prior to the start of the problem.
6. Steps already performed to reconcile the problem and/or results of any diagnostics.
7. The type of product being measured.
8. Operating environmental conditions under which the instrument is normally used, such as temperature, humidity, dust, fumes, etc.
9. Whether the instrument has recently been moved or the computer reconfigured.
10. The name(s) of any HunterLab personnel with whom you have previously discussed the problem.

The general number for HunterLab is 703-471-6870. To place an order, for prices on instruments, software, or replacement parts, or to return damaged or incorrect parts, ask for the ORDER PROCESSING DEPARTMENT. For applications advice, for help in correcting instrument or software problems, to return instruments to HunterLab for service, or to ask questions about the servicing or recalibration of instruments, ask for TECHNICAL SUPPORT.

HunterLab may also be contacted through its web site, www.hunterlab.com.

The mailing address for HunterLab headquarters is given below. Customers outside the United States should contact their HunterLab distributor for initial assistance.

Hunter Associates Laboratory, Inc.
11491 Sunset Hills Road
Reston, Virginia 20190 U.S.A.

Part IV. Reference

APPENDIX A

Measurement Values

Color values calculated using EasyMatch QC are relative to the absolute value of a perfect reflecting diffuser as measured under the same geometric conditions, according to the January 1, 1969 recommendation of the International Commission on Illumination, CIE. These values are traceable to measurements made at the National Institute of Standards and Technology.

All of the data types available for display within EasyMatch QC's Spectral Data Table view are described in the "Spectral Data Types" section at the end of this appendix. The remaining sections describe the color scales, color difference scales, indices, and read methods available for display in your Color Data Table view.

Color Scales and Related Color Difference Scales

CIE Tristimulus XYZ Scale

EasyMatch QC performs integration of reflectance/transmittance values over the visible spectrum to arrive at tristimulus X, Y, and Z values. These values simulate the color matching response functions of the human observer as defined by the 1931 2° Standard Observer or the 1964 CIE 10° Standard Observer (as selected). Tristimulus integrations based on any or all of the illuminants may be selected. For a complete description of how to calculate tristimulus values, refer to the publication CIE 15.2 and to ASTM Method E308.

The related color difference values are defined as follows:

$$dX = X_{SMP} - X_{STD} \qquad dY = Y_{SMP} - Y_{STD} \qquad dZ = Z_{SMP} - Z_{STD}.$$

CIE Chromaticity Coordinates, Yxy

The relationship between CIE XYZ values and the x,y chromaticity coordinates is as follows:

$$Y = \text{CIE Tristimulus Y (as above)} \qquad x = \frac{X}{X + Y + Z} \qquad y = \frac{Y}{X + Y + Z}$$

The related color difference values are defined as follows:

$$dY = Y_{SMP} - Y_{STD} \qquad dx = x_{SMP} - x_{STD} \qquad dy = y_{SMP} - y_{STD}.$$

Opponent-Color Scales (Hunter Lab, CIE 1976 L*a*b*, and CIE L*C*h)

The opponent-color scales give measurements of color in units of approximate visual uniformity throughout the color solid. Thus, in the **Hunter scale**, L measures lightness and varies from 100 for perfect white to zero for black, approximately as the eye would evaluate it. The chromaticity dimensions (a and b) give understandable designations of color as follows:

<u>a</u> measures redness when positive, gray when zero, and greenness when negative.
<u>b</u> measures yellowness when positive, gray when zero, and blueness when negative.

The relationship between the Hunter Lab Scale and the CIE XYZ Scale for the CIE 1931 2° Standard Observer and the CIE 1964 10° Standard Observer is as follows:

$$L = 100\sqrt{\frac{Y}{Y_n}}$$

$$a = K_a \frac{X/X_n - Y/Y_n}{\sqrt{Y/Y_n}}$$

$$b = K_b \frac{Y/Y_n - Z/Z_n}{\sqrt{Y/Y_n}}$$

where:

X, Y, and Z are the CIE tristimulus values obtained for the sample.

X_n, Y_n, and Z_n are tristimulus values of the standard illuminant as listed in ASTM E308 with Y_n always equal to 100.00 (normalized).

K_a and K_b are the ASTM E308 chromaticity coefficients for the illuminant used.

Illuminant **A** represents incandescent (tungsten) lamplight with an approximate color temperature of 2854 K. Illuminant **C** represents average, or north sky, daylight with a correlated color temperature of approximately 6770 K. Illuminants **D65**, **D50**, **D55**, and **D75** represent daylight with correlated color temperatures of approximately 6500 K, 5000 K, 5500 K, and 7500 K, respectively. Illuminants **F02** (cool white fluorescent), **F07**, and **F11** are fluorescent illuminants. **TL84** and **Ultra3000** are custom illuminants.

The Hunter Lab total color difference (dE) and chromaticity difference (dC) for any illuminant and observer are calculated as follows:

$$dE = \sqrt{dL^2 + da^2 + db^2}$$

$$dC = \sqrt{da^2 + db^2}$$

where:

$dL = L_{SMP} - L_{STD}$	(if + dL, sample is lighter than standard; if - dL, sample is darker than standard.)
$da = a_{SMP} - a_{STD}$	(if + da, sample is redder than standard; if - da, sample is greener than standard.)
$db = b_{SMP} - b_{STD}$	(if + db, sample is yellower than standard; if - db, sample is bluer than standard.)

The dE derived from these opponent-color scales approximates the NBS Unit of Color Difference (Judd-Hunter), which represents the average maximum difference acceptable in a series of dye-house commercial matches in 1939.

The **CIE 1976 L*a*b* Scale** is recommended by the Commission Internationale de l'Eclairage (CIE). It is a simplified cube root version of the Adams-Nickerson space produced by plotting the quantities of L*a*b* in rectangular coordinates.

The relationship between the CIE L*a*b* scale and the CIE XYZ scale for any illuminant referenced in ASTM E308 is as follows:

$$L^* = 116\ f\left(\frac{Y}{Y_n}\right) - 16$$

$$a^* = 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right]$$

$$b^* = 200\left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right]$$

where:

$$f\left(X/X_n\right) = \sqrt[3]{X/X_n} \qquad \text{if } X/X_n > (24/116)^3$$

$$f\left(\frac{X}{X_n}\right) = \left(841/108\right)\left(\frac{X}{X_n}\right) + \frac{16}{116} \qquad \text{if } X/X_n \le (24/116)^3$$

$$f\left(Y/Y_n\right) = \sqrt[3]{Y/Y_n} \qquad \text{if } Y/Y_n > (24/116)^3$$

$$f\left(\frac{Y}{Y_n}\right) = \left(841/108\right)\left(\frac{Y}{Y_n}\right) + \frac{16}{116} \qquad \text{if } Y/Y_n \le (24/116)^3$$

$$f\left(Z/Z_n\right) = \sqrt[3]{Z/Z_n} \qquad \text{if } Z/Z_n > (24/116)^3$$

$$f\left(\frac{Z}{Z_n}\right) = \left(841/108\right)\left(\frac{Z}{Z_n}\right) + \frac{16}{116} \qquad \text{if } Z/Z_n \le (24/116)^3$$

and X_n, Y_n, and Z_n are tristimulus values for any illuminant.

Total Difference (dE*), CIE 1976 a,b Chroma-Difference (dC*), and CIE 1976 a,b Hue Difference (dH*) are defined as follows:

$$dE^* = \sqrt{dL^{*2} + da^{*2} + db^{*2}}$$

$dC^* = C^*_{smp} - C^*_{std}$ where $C^* = \sqrt{a^{*2} + b^{*2}}$ and is termed metric chroma

$$dH^* = \sqrt{dE^{*2} - dL^{*2} - dC^{*2}}$$

where

$dL^* = L^*_{SMP} - L^*_{STD}$

$da^* = a^*_{SMP} - a^*_{STD}$

$db^* - b^*_{SMP} - b^*_{STD}$

For more information, see AATCC Test Method 173: *Calculation of Small Color Differences*.

CIE LCh is a modification to the CIELAB scale which plots in polar coordinates rather than rectangular ones.

dC* is the difference between the chroma of the sample and the chroma of the standard, as described in a polar coordinate system.

dh* describes the difference between the hue angle (h°) of the standard and the hue angle of the sample in a polar coordinate system, where:

If h°smp > h°std then dh* is regarded as positive.
If h°std > h°smp then dh* is regarded as negative.

See "Recommendation on Uniform Color Spaces, Color Difference Equations, Psychometric Color Terms," Supplement No. 2 to *CIE Publication No. 15* (E-1.3.1) CIE, Paris, 1978.

L^* = CIE 1976 psychometric lightness $= 116\sqrt[3]{\frac{Y}{Y_n}} - 16$

a^* = Red(+) - Green(-) axis $= 500\left(\sqrt[3]{\frac{X}{X_n}} - \sqrt[3]{\frac{Y}{Y_n}}\right)$

b* = Yellow(+) - Blue(-) axis = $200\left(\sqrt[3]{\frac{Y}{Y_n}} - \sqrt[3]{\frac{Z}{Z_n}}\right)$

C^*_{ab} = CIE 1976 a,b chroma= $\sqrt{a^{*2} + b^{*2}}$

h° = CIE 1976 a,b hue-angle = arctan (b*/a*)

dh* = $h°_{Std}$ - $h°_{Sam}$

dH^*_{ab} = CIE 1976 a,b hue-difference = $\sqrt{dE^{*2} - dL^{*2} - dC^{*2}}$

Note: Since hue angle changes dramatically for small differences in neutral and near-neutral colors, use of dH^*_{ab} hue difference is not recommended when C < 5. In this case, use dL*, da*, and db* instead to define color differences.*

dC* = Chromaticity difference in the a*b* plane = C^*_{smp} - C^*_{std}

dE^*_{ab} = CIE 1976 L*a*b* color difference formula = $\sqrt{dL^{*2} + da^{*2} + db^{*2}}$

d = Difference between Sample and Standard.

Reference: Commission International de l'Eclairage (CIE): "Recommendations on Uniform Color Spaces, Color Difference Equations, Psychometric Color Terms," Supplement No. 2 to *CIE Publication No. 15*, Colorimetry, Bureau Central de la CIE, Paris, 1978. For more information, see AATCC Test Method 173: *Calculation of Small Color Differences*.

Hunter Rdab Color Scale

The relationship between the Hunter Rd,a,b values and the CIE XYZ values for any illuminant is as follows:

$$L(Rd) = Y$$

$$a(Rd) = K_a f(Y)\left(\frac{X}{X_n} - \frac{Y}{Y_n}\right)$$

$$b(Rd) = K_b f(Y)\left(\frac{Y}{Y_n} - \frac{Z}{Z_n}\right)$$

where

$$f(Y) = 0.51\ \frac{21 + 0.2Y}{1 + 0.2Y}.$$

X, Y, and Z are the CIE tristimulus values obtained for the sample.

X_n, Y_n, and Z_n are the tristimulus values of the standard illuminant with Y_n always equal to 100.00 (normalized).

K_a and K_b are the chromaticity coefficients for the illuminant used.

and

$dR\ Rdab = L(Rd)_{SMP} - L(Rd)_{STD}$

$da\ Rdab = a(Rd)_{SMP} - a(Rd)_{STD}$

$db\ Rdab - b(Rd)_{SMP} - b(Rd)_{STD}$

$$dE\ Rdab = \sqrt{dR\ Rdab^2 + da\ Rdab^2 + db\ Rdab^2}$$

$$dC\ Rdab = \sqrt{da(Rd)^2 + db(Rd)^2}$$

RxRyRz Reflection Factors

The Reflection Density Color Scale, Rx, Ry, Rz, is a variation of the CIE XYZ scale, where Rx is corrected to represent only the amber peak of the tristimulus X bi-modal response. This scale was originally developed for measurement of pulp and paper using tristimulus colorimeters. The formulas for calculating Rx, Ry, and Rz are shown below.

$Rx = (100*X/X_{wp}) - 0.202*Rz$

$Ry = Y$

$Rz = 100*Z/Z_{wp}$

where

X_{wp} = X of white point for selected illuminant/observer combination

Z_{wp} = Z of white point for selected illuminant/observer combination.

$dRx = Rx_{SMP} - Rx_{STD}$

$dRy = Ry_{SMP} - Ry_{STD}$

$dRz - Rz_{SMP} - Rz_{STD}$

Other Color Difference Scales

Elliptical Tolerancing Scales (CMC, CIE94, DIN99, and CIE00)

CMC

The equation for dE CMC describes an ellipsoidal volume with axes in the direction of lightness (l), chroma (c), and hue (h) centered about a standard. When the semi-axis lengths for the dE CMC formula equal the calculated lSL, cSC, and SH values for the standard, the resulting ellipsoid describes a 1.0 dE CMC unit volume/tolerance. This volume and the size of its component parts become the basis for the establishment of an appropriately sized volume of acceptability for a given commercial situation by the application of a commercial factor (cf). The cf is the dE CMC tolerance.

When l = 2.0 and c = 1.0, the equation fixes the ratio of the three components (SL:SC:SH) to correlate with visible assessment of typical textile samples. Other values of l may be required in cases where the surface characteristics change dramatically. The value of c is always left at 1.0.

$$\mathrm{dE\ CMC} = \mathrm{cf} = \sqrt{\left(\frac{\mathrm{dL}^*}{\mathrm{lSL}}\right)^2 + \left(\frac{\mathrm{dC}^*}{\mathrm{cSC}}\right)^2 + \left(\frac{\mathrm{dH}^*}{\mathrm{SH}}\right)^2} \qquad \text{Absolute}$$

$$\mathrm{dL\ CMC} = \frac{\mathrm{dL}^*}{\mathrm{lSL}}$$

$$\mathrm{dC\ CMC} = \frac{\mathrm{dC}^*}{\mathrm{cSC}}$$

$$\mathrm{dH\ CMC} = \frac{\mathrm{dH}^*}{\mathrm{SH}}$$

where

L*, C*, and H* are those of the standard unless otherwise specified.

CMC ratio l:c. This ratio is generally 1:1 for coatings, 1.3:1 for plastics, and 2:1 for textiles. The l value may be set anywhere between 0 and 5. The l:c ratio determines the shape of the ellipsoid.

commercial factor cf. This value is usually one to represent a just-perceptible difference, but this value may be adjusted for the industry and the product. This value may be set anywhere between 0.10 and 9.99. The commercial factor determines the size of the ellipsoid.

$$\mathrm{SL} = \frac{0.040975\mathrm{L}^*}{1 + 0.01765\mathrm{L}^*} \qquad \text{for } \mathrm{L}^* \geq 16$$

$$\mathrm{SL} = 0.511 \qquad \text{for } \mathrm{L}^* < 16$$

$$\mathrm{SC} = \frac{0.0638\mathrm{C}^*}{1 + 0.0131\mathrm{C}^*} + 0.638$$

SH = (FT + 1 - F) SC

$$C^* = \sqrt{a^{*2} + b^{*2}}$$

$$h^\circ = \arctan\left(\frac{b^*}{a^*}\right)$$

$dL^* = L^*_{SMP} - L^*_{STD}$

$dC^* = C^*_{SMP} - C^*_{STD}$

$$dH^* = \sqrt{dE^{*2} - dL^{*2} - dC^{*2}}$$

$$F = \sqrt{\frac{C^{*4}}{C^{*4} + 1900}}$$

T = 0.36 + |0.4 cos (35 + h)| if h = 164° or h > 345°

T = 0.56 + |0.2 cos (168 + h)| if 164° < h < 345°

Tolerances are:		
	dL* = (cf) lSL	dL* CMC = cf
	dC* = (cf) cSC	dC* CMC = cf
	dH* = (cf) SH	dH* CMC = cf
		dE CMC = cf

For a more detailed description of CMC, refer to *Calculation of Small Color Differences for Acceptability*, AATCC Test Method 173-1992 published in the AATCC Technical Manual.

CIE TC 1-29

CIE TC 1-29, also called the CIE 1994 (dL CIE94 dC CIE94 dH CIE94) color difference scale, is a test scale that may eventually be approved as an official CIE scale.

dE CIE94 is the total color difference.

$$dE\ CIE94 = K_v * \left[\left(\frac{dL\ CIE94}{K_L\ S_L}\right)^2 + \left(\frac{dC\ CIE94}{K_C\ S_C}\right)^2 + \left(\frac{dH\ CIE94}{K_H\ S_H}\right)^2\right]^{1/2}$$

where:

dL CIE94, dC CIE94, and dH CIE94 are as described earlier in this section (as dL*, dC*, and dH*)

SL = 1

SC = 1 + 0.045 C*

SH = 1 + 0.015 C*.

K_L:K_C:K_H ratio. This ratio is generally 1:1:1 for coatings, 1.3:1:1 for plastics, and 2:1:1 for textiles.

DIN99

The German standards institute (DIN) developed the DIN99 standard as a new color difference formula that globally models color space using logarithms of the CIELAB coordinates rather than the linear and hyperbolic functions of CMC and CIE94. This new formula is easy to use and has equivalent performance to CMC or CIE94. It also eliminates the reference-color based distortion of CIELAB. It is calculated as follows:

Redness e = cos(16°)a* + sin(16°)b*

Yellowness f = -0.7[-sin(16°)a* + cos(16°)b*]

Chroma G = $(e^2 + f^2)^{0.5}$

Hue angle h_{ef} = arctan(f/e)

Chroma C DIN99 = $\dfrac{\left(\log_e\left(1+0.045\mathrm{G}\right)\right)}{0.045\mathrm{k}_{\mathrm{CH}}\mathrm{k}_{\mathrm{E}}}$

Hue angle h DIN99 = $\mathrm{h}_{\mathrm{ef}}\dfrac{180}{\Pi}$

Redness a DIN99 = C DIN99 cos h_{ef}

Yellowness b DIN99 = C DIN99 sin h_{ef}

Lightness L DIN99 = 105.509 [$\log_e$ (1 + 0.0158 L*)] k_E

$$\mathrm{dE\ \ DIN99} = \sqrt{(\mathrm{dL\ DIN99})^2 + (\mathrm{da\ DIN99})^2 + (\mathrm{db\ DIN99})^2}$$

dC DIN99 = C $\mathrm{DIN99}_{\mathrm{sample}}$ - C $\mathrm{DIN99}_{\mathrm{standard}}$

dH DIN99 =

$$\frac{\left(\mathrm{a\ DIN99}_{\mathrm{standard}} * \mathrm{b\ DIN99}_{\mathrm{sample}} - \mathrm{a\ DIN99}_{\mathrm{sample}} * \mathrm{b\ DIN99}_{\mathrm{standard}}\right)}{\sqrt{0.5 * \left(\mathrm{C\ DIN99}_{\mathrm{sample}} * \mathrm{C\ DIN99}_{\mathrm{standard}} + \mathrm{a\ DIN99}_{\mathrm{sample}} * \mathrm{a\ DIN99}_{\mathrm{standard}} + \mathrm{b\ DIN99}_{\mathrm{sample}} * \mathrm{b\ DIN99}_{\mathrm{standard}}\right)}}.$$

where

$k_E = k_{CH}$ = 1 by default.

CIELAB2000

The CIELAB2000 Color Difference Equation is a ellipsoidal color difference scale similar to CMC, and is described below.

dE* 2000 is the total color difference.

$$dE^*2000 = \left[\left(\frac{dL^*2000}{KL\,S_L}\right)^2 + \left(\frac{dC^*2000}{KC\,S_C}\right)^2 + \left(\frac{dH^*2000}{KH\,S_H}\right)^2 + R_T\left(\frac{dC^*2000}{KC\,S_c}\right)\left(\frac{dH^*2000}{K_L\,S_H}\right)\right]^{1/2}$$

where:

dL* 2000, dC* 2000, and dH* 2000 are as described earlier in this chapter (as dL*, dC*, and dH*)

KL:KC:KH ratio. This ratio is generally 1:1:1 for coatings, 1.3:1:1 for plastics, and 2:1:1 for textiles.

SL = 1

SC = 1 + 0.045 C^*_{ab}

SH = 1 + 0.015 C^*_{ab}

R_T = Rotation function = -sin(2ΔΘ)R_C

$$\Delta\Theta = 30 \exp\left[-\left(\frac{\bar{h} - 275}{25}\right)^2\right]$$

$$R_C = 2\left(\frac{\overline{C^*00}^{\,7}}{\overline{C^*00}^{\,7} + 25^7}\right)^{1/2}.$$

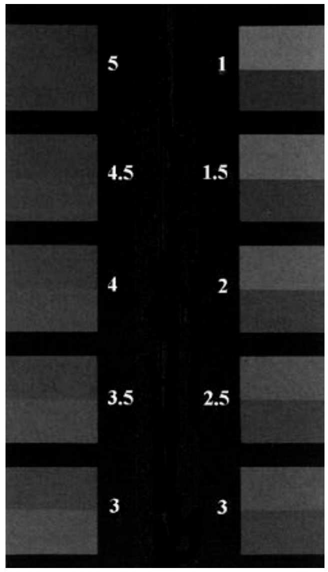
FMC-2 (Friele - MacAdam - Chickering) Color Difference

Red-green (dRedGrn FMCII) differences, yellow-blue (dYelBlu FMCII) differences, total lightness differences (dL FMCII), and total color differences (dE FMCII) between standard and sample are computed according to the Friele-MacAdam-Chickering metric (*JOSA*, February 1968, p. 292 and August 1969, p. 986).

The FMC-2 unit of color difference is based on just noticeable, or threshold, color difference data published in 1942. Friele used the data in his suggested color-difference formula, which was modified later by MacAdam, and then by Chickering. The FMC-2 Scale is a color difference scale only and was designed for Illuminant C and 2° standard observer conditions only. It has been successfully used for non-saturated colors under illuminants D65 and A as well as 10° standard observer conditions.

ISO Grey Scale

ISO Grey Scale indicates the amount of fading or color alteration that occurs with environmental exposure or washing of textiles. The loss of color using the ISO Grey Scale is evaluated by comparison to five pairs of gray standards similar to those shown below. One half of each standard is always of identical chroma to the starting specimen. The second half ranges from the starting chroma (no loss of color) to white (loss of all color). The amount of contrast between the treated and untreated fabric is related to one of the standard pairs to yield the gray scale rating. On this scale, 5 indicates that next to no color was lost, and 1 indicates that most color was lost.



The bottom half of each pair shows the starting color. The top half shows the color of the treated fabric. (Illustration from AATCC Evaluation Procedure 1.)

ISO Grey Scale, as implemented in EasyMatch QC, is based on ISO 105-A02:1993, Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour. It is intended as an alternative to visual assessment as described in AATCC Evaluation Procedure 1, “Gray Scale for Color Change.” It may be used in assessing any samples except those which have been treated with fluorescent whitening agents.

The ISO Grey Scale result is based on the calculations below. Some terms were further explained earlier in this chapter under “Opponent-Color Scales.”

$$dEf = \sqrt{dL^{*2} + dCf^{*2} + dHf^{*2}}$$

where

$$dHf = \frac{dHk}{1 + \left(10C_M / 1000\right)^2}$$

$$dCf = \frac{dCk}{1 + \left(20C_M / 1000\right)^2}$$

$$dHk = dH^*_{ab} - d$$

$$dCk = dC^*_{ab} - d$$

$$d = \frac{dC^*_{ab}\, C_M\, e^{-x}}{100}$$

$$x = \left[\frac{h_M - 280}{30}\right]^2 \qquad \text{if } |h_M - 280| \le 180$$

$$x = \left[\frac{360 - |h_M - 280|}{30}\right]^2 \qquad \text{if } |h_M - 280| > 180$$

$$C_M = \frac{C_{abT} + C^*_{abO}}{2}$$

$$h_M = \frac{h_{abT} + h_{abO}}{2} \qquad \text{if } |h_{abT} - h_{abO}| \le 180$$

$$h_M = \frac{h_{abT} + h_{abO}}{2} + 180 \qquad \text{if } |h_{abT} - h_{abO}| > 180 \text{ and } |h_{abT} + h_{abO}| < 360$$

$$h_M = \frac{h_{abT} + h_{abO}}{2} - 180 \qquad \text{if } |h_{abT} - h_{abO}| > 180 \text{ and } |h_{abT} + h_{abO}| \ge 360$$

L^*_T, C^*_{abT}, h_{abT} = lightness, chroma, and hue of Test specimen

L^*_O, C^*_{abO}, h_{abO} = lightness, chroma, and hue of Original

$dL^* = L^*_T - L^*_O$

$dC^*_{ab} = C^*_{abT} - C^*_{abO}$

sign of dH^*_{ab} = sign of $(h_{abT} - h_{abO})$

$$dH^*_{ab} = \sqrt{dE^{*2}_{ab} - dL^{*2} - dC^{*2}_{ab}}$$

$$dE^*_{ab} = \sqrt{dL^{*2} + da^{*2} + db^{*2}}$$

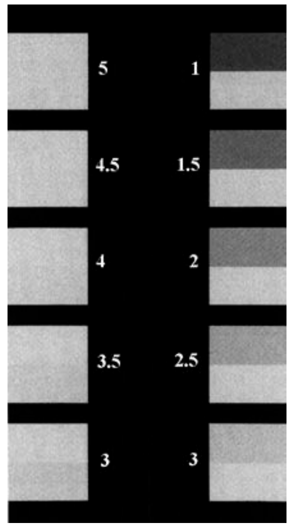
dEf is used to calculate ISO Grey Scale using the equations below:

$$\text{ISO Grey Scale} = 5 - \frac{dEf}{1.7} \qquad \text{if } dEf \le 3.4$$

$$\text{ISO Grey Scale} = 5 - \frac{\log\left(dEf/0.85\right)}{\log(2)} \qquad \text{if } dEf > 3.4.$$

ISO Grey Stain

The transference of color from the test specimen to an adjacent specimen is evaluated in a manner very similar to that of ISO Grey Scale. Again, five standard pairs are used. One half of each standard is white, and the second half range ranges from white (no staining) to a gray with the chroma value of the test specimen (great deal of staining). A value of 5 corresponds to virtually no staining, whereas 1 indicates poor color fastness.



The bottom half of each pair shows the starting color of the adjacent fabric. The top half shows the color of the treated adjacent fabric. (Illustration from AATCC Evaluation Procedure 2).

ISO Grey Stain, as implemented in EasyMatch QC, is based on ISO 105-A04:1989, Textiles — Tests for colour fastness — Part A04: Method for the instrumental assessment of the degree of staining of adjacent fabrics. It is intended as an alternative to visual assessment as described in AATCC Evaluation Procedure 2, "Gray Scale for Staining."

The ISO Grey Stain result is based on the calculations below.

$$dE_{GS} = dE^* - 0.4\sqrt{dE^{*2} - dL^{*2}}$$

Use dE_{GS} to calculate the SSR as follows:

ISO Grey Stain = 6.1 - 1.45 ln (dE_{GS})for Ratings 1 to 4.

If SSR calculated by the above equation is greater than 4, recalculate using the following equation:

ISO Grey Stain = 5 - 0.23dE_{GS} for Ratings 4 to 5.

Metamerism Index

The Metamerism Index is designed to indicate the degree to which two samples which match under one illuminant no longer match under a second illuminant. The metamerism index feature allows the comparison of Hunter Lab values relative to operator-selectable illuminants. These values must be calculated from spectral reflectance values. The formula for deriving the index is:

$$\text{Metamerism Index} = \sqrt{(dL_{n1} - dL_{n2})^2 + (da_{n1} - da_{n2})^2 + (db_{n1} - db_{n2})^2}$$

where n1 is the 1st illuminant and n2 is the 2nd illuminant, and d = $\text{Value}_{\text{sample}}$ - $\text{Value}_{\text{standard}}$.

Strength

% Strength SUM

% Strength SUM, also known as Relative Average Strength, is calculated as follows:

$$\%\,\text{Strength SUM} = \frac{\text{Color Value SUM}_{\text{SAM}}}{\text{Color Value SUM}_{\text{STD}}}\ \text{x}\ 100.0$$

Color Value SUM is defined in the "Indices" section of this appendix. % Strength WSUM is preferred over % Strength SUM for measurements made in reflectance.

% Strength SWL

% Strength SWL (single wavelength) is the % Strength measured at the wavelength of maximum absorbance. This is the same % Strength described in the "Spectral Data Types" section of this appendix, but at the appropriate single wavelength.

% Strength WSUM

% Strength WSUM, also known as Relative Weighted Strength, is calculated as follows:

$$\%\,\text{Strength WSUM} = \frac{\text{Color Value WSUM}_{\text{SAM}}}{\text{Color Value WSUM}_{\text{STD}}}\ \text{x}\ 100.0$$

Color Value WSUM is defined in the "Indices" section of this appendix. % Strength SUM is preferred over % Strength WSUM for measurements made in transmission.

Indices and Related Difference Scales

a/b Ratio

a/b Ratio is simply the a of Hunter L, a, b divided by the b of Hunter L, a, b.

a/b Difference is also available, and is defined as follows:

$da/b = (a/b)_{sample} - (a/b)_{standard.}$

a*/b* Ratio

a*/b* Ratio is simply the a* of CIEL*a*b* divided by the b* of CIEL*a*b*.

a*/b* Difference is also available, and is defined as follows:

$da^*/b^* = (a^*/b^*)_{sample} - (a^*/b^*)_{standard.}$

ADMI-10 mm, -20 mm, and -50 mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

The American Dye Manufacturer's Institute (ADMI) scale was developed for the measurement of wastewater containing dyestuffs and textile effluents. This scale may be used on clear liquids of any color.

ADMI units are based on the total AnLab color difference of APHA solutions from distilled water. Distilled water has a value of zero in ADMI units, as it does in APHA units. An ADMI value of 500 is assigned to a solution having a total color difference from distilled water equal to the total color difference from distilled water of the APHA stock solution, which has an APHA value of 500.

The HunterLab application of this scale is designed for use with bluish liquids. Be certain to use the size of transmission cell corresponding to the scale you are calculating. The sensor should be standardized in TTRAN mode using a clear liquid in that cell as a blank.

When an APHA/PtCo standard solution that conforms to ASTM D1209 is prepared and read on your instrument, it should read within the repeatability specifications of ASTM D1209. An APHA 400 solution should read as ADMI 400. ADMI values are reported in C/2° regardless of the illuminant and observer selected.

APHA is described below.

ADMI Difference is also available, and is defined as follows:

$\text{dADMI-10 mm} = (\text{ADMI-10 mm})_{sample} - (\text{ADMI-10 mm})_{standard,}$

$\text{dADMI-20 mm} = (\text{dADMI-20 mm})_{sample} - (\text{dADMI-20 mm})_{standard.}$

and

$\text{dADMI-50 mm} = (\text{dADMI-50 mm})_{sample} - (\text{dADMI-50 mm})_{standard.}$

APHA-10, -20, and -50 mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

The American Public Health Association (APHA) Index was developed in the 1890s as a visual indicator of the purity of wastewater, where color is due to the presence of naturally-occurring organic materials such as leaves, bark, roots, humus, and peat. Today, APHA is used as a metric for purity in the chemical, oil, plastics, and pharmaceutical industries. This scale serves to quantify the appearance of yellowness, a visual indicator of product degradation due to light and/or heat, the presence of impurities, and the effects of processing.

APHA-10, -20, and -50 mm are designed to yield APHA/PtCo values that closely correlate to APHA/PtCo standard solution values as defined by ASTM D1209. They are calculated from the YI E313 yellowness index and are optimized for each instrument. This index is calculated only for the C/2° illuminant/observer combination.

A transmission cell with 10-, 20-, or 50-mm path length is required for this metric.

To measure APHA Color, follow the steps below:

1. Configure your Color Data Table to include APHA-10, -20, or -50 mm as an index for display.

2. Standardize the sensor in TTRAN (total transmittance) mode on a clear liquid (distilled water is suggested for water-based samples, toluene or benzene for resins, and mineral oil for oils) in a cell of the desired size. Place the cell in the transmission compartment as close to the sphere as possible. When APHA is in the Color Data Table and the instrument is not a ColorQuest II Sphere, the instrument flashes three times for each reading in the standardization sequence.

3. Place the white calibrated tile at the reflectance port and leave it there for the APHA measurements.

4. Read the standards and/or samples in a cell of the desired size. Place the sample cell in the transmission compartment as close to the sphere as possible. The APHA value will appear in your displays and on your printouts. When APHA is in the Color Data Table and the instrument is not a ColorQuest II Sphere, the instrument flashes three times for each reading.

APHA Difference is also available, and is defined as follows:

$$dAPHA\text{-}10\ mm = (APHA\text{-}10\ mm)_{sample} - (APHA\text{-}10\ mm)_{standard,}$$

$$dAPHA\text{-}20\ mm = (dAPHA\text{-}20\ mm)_{sample} - (dAPHA\text{-}20\ mm)_{standard.}$$

and

$$dAPHA\text{-}50\ mm = (dAPHA\text{-}50\ mm)_{sample} - (dAPHA\text{-}50\ mm)_{standard.}$$

ASBC-10 mm (ColorQuest XE, ColorQuest XT, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

The American Society of Brewing Chemists (ASBC) scale is used in the measurement of the color of beer, malt worts, caramel solutions, and similarly-colored liquids. This transmission scale, which should be measured using a cell path length of 10 mm, is based on the EBC scale, which is described later in this chapter. Its range is approximately 1 to 11 units, with the more yellow, pale worts at the low end of the scale and the redder color of dark worts, beers, and caramels at the upper end of the scale. Applicable equations are given below.

$$ASBC = 10 * 1.27 * -\log_{10}(T_{430\,nm})$$

where

$T_{430\,nm}$ = measured transmittance value (%) at 430 nm

and

Turbidity = free ("0.0") if $1.27 * -\log_{10}\left(\frac{T_{700\,nm}}{100}\right) \leq 0.039 * 1.27 * -\log_{10}(T_{430\,nm})$, else turbid ("1.0").

where

$T_{700\,nm}$ = measured transmittance value (%) at 700 nm.

ASBC Difference is also available, and is defined as follows:

dASBC-10 mm = $(\text{ASBC-10 mm})_{sample}$ - $(\text{ASBC-10 mm})_{standard.}$

ASTM D1500-33 mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

The ASTM D1500 scale is calculated as described below.

$$D1500 = 0.25 + 0.8695\ (DX + DY + DZ)$$

where

$$DX = -\log\left(\frac{X}{98.078}\right)$$

$$DY = -\log\left(\frac{Y}{100.00}\right)$$

$$\text{if } Z > 0.01,\ DZ = -\log\left(\frac{Z}{118.24}\right)$$

$$\text{if } Z \leq 0.01,\ DZ = -\log\left(\frac{0.01}{118.24}\right)$$

X is the X tristimulus value for the sample calculated for C/2° conditions

Y is the Y tristimulus value for the sample calculated for C/2° conditions

Z is the Z tristimulus value for the sample calculated for C/2° conditions.

For values greater than 8, 8 is displayed. For values less than 0, 0 is displayed.

When the D1500 function is optimized, the following equation is used:

$$D1500^* = \alpha + \beta\,(DX + DY + DZ)$$

where

DX, DY, DZ, X, Y, and Z are as described above

α is the intercept correction constant entered by the user

β is the slope correction constant entered by the user.

To obtain the D1500 value for a specimen, complete the steps below.

1. Standardize the instrument in a transmission mode using clear liquid in a 33-mm transmission cell for setting the top of scale.
2. Select ASTM D1500-33 mm and ASTM D1500 Dilution Factor as indices for display in the Color Data Table.
3. Two columns will be added to the color data table, one for the index and another for the dilution factor.
4. To edit the scale constants, choose **Adjust Scale Factors** from the **Options** menu and then **ASTM D1500-33mm** from the submenu. Click **OK,** edit the constants, and indicate the dilution factor as desired.
5. Measure the sample desired in a 33-mm transmission cell. The ASTM D1500-33 mm value will be displayed in that column and the dilution factor will be displayed in the ASTM D1500 Dilution Factor column.

When ASTM D1500 data is recalled, the dilution factor will be correctly displayed and the index value will be recalculated based on the current constants.

ASTM D1500 Difference is also available, and is defined as follows:

$$\text{dASTM D1500-33 mm} = (\text{ASTM D1500-33 mm})_{sample} - (\text{ASTM D1500-33 mm})_{standard.}$$

b/a Ratio

b/a Ratio is simply the b of Hunter L, a, b divided by the a of Hunter L, a, b.

b/a Difference is also available, and is defined as follows:

$$db/a = (b/a)_{sample} - (b/a)_{standard.}$$

b*/a* Ratio

b*/a* Ratio is simply the b* of CIEL*a*b* divided by the a* of CIEL*a*b*.

b*/a* Difference is also available, and is defined as follows:

$$db^*/a^* = (b^*/a^*)_{\text{sample}} - (b^*/a^*)_{\text{standard.}}$$

Brightness 457

457 nm Brightness can be used to measure the relative brightness of paper. 457 nm brightness is calculated over the range of 400 nm to 510 nm in accordance with TAPPI document T452. While HunterLab's spectrophotometer geometries do not conform exactly to those specified by TAPPI, the measurements correlate closely with those made on TAPPI-compliant instruments.

457 nm Brightness Difference is also available, and is defined as follows:

$$\text{d457nm Brightness} = (\text{457nm Brightness})_{\text{sample}} - (\text{457nm Brightness})_{\text{standard.}}$$

Color Value

Color Value is a single numerical value related to the amount of light-absorbing material (colorant) contained in a sample and is usually based on spectral data. It is most often used to calculate the difference in strength (% Strength) between a standard and a sample. Color Value may be calculated by any one of three acceptable methods. The color value which results from one method may not agree with any other method. The choice of method is usually dependent on the nature of the sample and the need to obtain a color value. The Spectrophotometric methods for obtaining color value are labeled as Color Value SUM, Color Value SWL, and Color Value WSUM, as described below.

Color Value SUM

Color Value SUM is calculated as the sum of the K/S values for the sample read across the spectrum for reflectance measurements, and from the sum of the absorbances for the sample read across the spectrum for transmittance measurements.

$$\text{Color Value SUM} = \frac{\sum_{\lambda=1}^{\#\text{points}} \frac{K}{S\lambda}}{\#\text{points}} \qquad \text{for reflectance}$$

$$\text{Color Value SUM} = \frac{\sum_{\lambda=1}^{\#\text{points}} \text{Absorbance}_{\lambda}}{\#\text{points}} \qquad \text{for transmittance.}$$

K/S and Absorbance are described in the Spectral Data Types section of this appendix.

Color Value SUM Difference is also available, and is defined as follows:

$$\text{dColor Value SUM} = (\text{Color Value SUM})_{\text{sample}} - (\text{Color Value SUM})_{\text{standard.}}$$

Color Value SWL

Color Value SWL is the K/S measured at the wavelength of maximum absorption (minimum reflection) for reflectance measurements or the absorbance at the wavelength of maximum absorption (minimum transmittance) for transmittance measurements. K/S and Absorbance are described in the Spectral Data Types section of this appendix.

Color Value SWL Difference is also available, and is defined as follows:

dColor Value SWL = $(\text{Color Value SWL})_{\text{sample}}$ - $(\text{Color Value SWL})_{\text{standard}}$.

Color Value WSUM

Color Value WSUM is calculated using the sum of K/S weighted by illuminant and observer for the sample read the spectrum for reflectance measurements, and using the sum of absorbances weighted by illuminant and observer for the sample read across the spectrum for transmittance measurements.

$$\text{Color Value WSUM} = \frac{\sum_{\lambda=1}^{\#\,\text{points}} \frac{K}{S_\lambda} * E_\lambda * S_\lambda}{\#\,\text{points}} \qquad \text{for reflectance}$$

$$\text{Color Value WSUM} = \frac{\sum_{\lambda=1}^{\#\,\text{points}} \text{Absorbance}_\lambda * E_\lambda * S_\lambda}{\#\,\text{points}} \qquad \text{for transmittance}$$

where E = Energy distribution of light source

S = Observer function.

K/S and Absorbance are described in the Spectral Data Types section of this appendix.

Color Value WSUM Difference is also available, and is defined as follows:

dColor Value WSUM = $(\text{Color Value WSUM})_{\text{sample}}$ - $(\text{Color Value WSUM})_{\text{standard}}$.

Dominant WaveLength and Excitation Purity

The dominant wavelength and excitation purity chromaticity system was one of the first systems for specifying the chromaticity of objects other than by their x, y values. It not only compensates for the influence of the illuminant's chromaticity, but also improves the correlation between the numbers and visual attributes because it permits chromaticity specification in terms of hue and saturation. The system is based on the additive-color-mixing properties of the x,y diagram. A color is specified by describing how it would be matched by additively mixing the illuminant and light of some single wavelengths.

Dominant wavelength is the wavelength needed for mixture with the illuminant. In general, it identifies the hue of the object's color.

Excitation purity is the percentage contribution of the dominant wavelength to the mixture. Thus, 1.00 is the purity of all spectral colors and 0 is the purity of the illuminant. Excitation purity correlates with saturation.

In order to derive dominant wavelength and excitation purity for a sample, plot the position of the illuminant C - object color combination on the CIE x,y chromaticity diagram. The dominant wavelength for sample (S) under illuminant C is found by drawing a straight line from the Illuminant C point through S to the spectrum locus, where it intersects at the dominant wavelength. Excitation purity is the percentage of the distance from illuminant C to S compared to the total distance from illuminant C to the spectrum locus.

Dominant wavelength and excitation purity are calculated for the wavelengths of 397-673 nm. These values are always calculated and displayed relative to the CIE 1931 2° standard observer and CIE illuminant C regardless of the selected illuminant and observer. For complementary wavelengths, the displayed values are less than zero.

For further information see "A Digital Computer Technique for Calculation of Dominant Wavelength" by Charles G. Leete and Jack R. Lytle in *Color Engineering*, Volume 4, No. 1 (January - February 1966).

Dominant Wavelength Difference and Excitation Purity Difference are also available, and are defined as follows:

$$\text{dDominant Wavelength} = (\text{Dominant Wavelength})_{\text{sample}} - (\text{Dominant Wavelength})_{\text{standard}},$$

$$\text{dExcitation Purity} = (\text{Excitation Purity})_{\text{sample}} - (\text{Excitation Purity})_{\text{standard}}.$$

EBC-10 mm (ColorQuest XE, ColorQuest XT, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

The European Brewing Chemists (EBC) scale is used in the measurement of color of beer, malt worts, caramel solutions, and similarly-colored liquids. The range of this transmission scale is 2 to 27 units, with yellower, pale worts at the low end and redder dark worts, beers, and caramels at the upper end. A 10-mm path length cell should be used for these measurements. EBC values are calculated as follows:

$$\text{EBC} = 25f * -\log_{10}\left(T_{430\,\text{nm}}\right)$$

where

f = EBC dilution factor (default = 1.0)

$T_{430\text{ nm}}$ = measured transmittance value (%) at 430 nm

and

$$\text{Turbidity} = \text{free ("0.0") if } 1.27 * -\log_{10}\left(\frac{T_{700\,\text{nm}}}{100}\right) \leq 0.039 * 1.27 * -\log_{10}\left(T_{430\,\text{nm}}\right)\text{, else turbid ("1.0").}$$

where

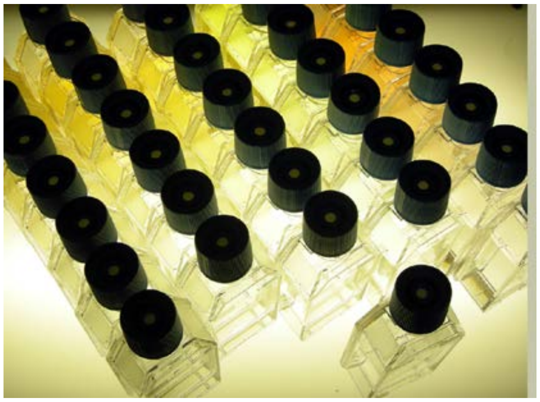
$T_{700\ nm}$ = measured transmittance value (%) at 700 nm.

EBC Difference is also available, and is defined as follows:

$$dEBC\text{-}10\ mm = (EBC\text{-}10\ mm)_{sample} - (EBC\text{-}10\ mm)_{standard.}$$

EP 10-mm and EP 20-mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

EP (European Pharmacopoeia Color) is a visual liquid color index used in the pharmaceutical industry. It consists of three primary color standard solutions (yellow, red, and blue) that are combined to produce five standard color solutions: B (brown), BY (brownish-yellow), Y (yellow), GY (greenish-yellow), and R (red). These standards are then diluted with hydrochloric acid to make 37 reference EP liquid color standards: 9 Bs, 7 BYs, 7 Ys, 7 GYs, and 7 Rs.



The EP physical standards

A HunterLab spectrophotometer standardized in a transmission mode may be used to instrumentally determine the closest EP standard to any sample solution read. Samples should be measured using a 10-mm or 20-mm path length transmission cell, choosing the matching version of the EP index for display. The EP standard value (or "Water" if the sample is closest to water white) is then reported.

Refer to European Pharmacopoeia Method 2.2.2, "Degree of Coloration of Liquids," for more information.

Gardner-20 mm and D6166 (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

The Gardner indices are designed for transmission measurements of samples, such as resins, that are darker yellow or browner than those samples that would be measured with the APHA index. Samples should be measured using a 10-mm path length transmission cell for the D6166 index and a 20-mm cell for the 20-mm index.

The **Gardner-20 mm** index is a proprietary yellowness index based upon a correlation between ASTM YI E313 and Gardner Color.

Gardner-20 mm Difference is also available, and is defined as follows:

$$dGardner\text{-}20\ mm = (Gardner\text{-}20\ mm)_{sample} - (Gardner\text{-}20\ mm)_{standard.}$$

The **D6166** index conforms to ASTM Method D6166 and uses a look-up table to determine Gardner Color based on the sample's Yxy (C/2°) values.

Gardner Color	Y	x	y
1	80	0.3177	0.3303
2	79	0.3233	0.3352
3	76	0.3329	0.3452
4	75	0.3437	0.3644
5	74	0.3558	0.3840
6	71	0.3767	0.4061
7	67	0.4044	0.4352
8	64	0.4207	0.4498
9	61	0.4343	0.4640
10	57	0.4503	0.4760
11	45	0.4842	0.4818
12	36	0.5077	0.4638
13	30	0.5392	0.4458
14	22	0.5646	0.4270
15	16	0.5857	0.4089
16	11	0.6047	0.3921
17	6	0.6290	0.3701
18	4	0.6477	0.3521

Gardner D6166 is calculated as follows:

$$G_{TM} = G_I + G_F$$

where

G_{TM} = the Gardner color of the test material

G_I = the integer portion of the test material's Gardner color value

G_F = the fractional portion of the Gardner color value.

By comparing the x chromaticity coordinate of the test material with the x chromaticity coordinates for the D1544 visual Gardner Color standards, the integer portion of the Gardner color can be determined using this equation:

$$G_I = G_n \text{, where } x_n \le x_{TM} < x_{n+1}$$

where

G_n = the Gardner color value which is lighter than the test material

x_n = the x chromaticity coordinate of the Gardner color standard which is lighter than the test material

x_{TM} = the x chromaticity coordinate of the test material

x_{n+1} = the x chromaticity coordinate of the Gardner color standard which is darker than the test material.

The fractional portion of the Gardner color is calculated as follows:

$$G_F = \frac{(x_{n+1} - x_n)(x_{TM} - x_n) + (y_{n+1} - y_n)(y_{TM} - y_n)}{(x_{n+1} - x_n)^2 + (y_{n+1} - y_n)^2}$$

where

y_n = the y chromaticity coordinate of the Gardner color standard which is lighter than the test material

y_{TM} = the y chromaticity coordinate of the test material

y_{n+1} = the y chromaticity of the Gardner color standard which is darker than the test material

x_n, x_{n+1}, and x_{TM} are as defined above.

Available values range from 0.1 to 18.0 for both Gardner scales. A value of zero or 18.1 indicates the value is out of range.

Gardner D6166 Difference is also available, and is defined as follows:

dGardner D6166 = $(\text{Gardner D6166})_{sample}$ - $(\text{Gardner D6166})_{standard}$.

Saybolt-50/100 mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

The Saybolt index is calculated as described below. These calculations adjust the spectral data to account for use of a 50-mm sample cell rather than a 100-mm cell, so spectral data must be available for this type of calculation.

$$\text{Saybolt} = 51.1 + \left(\frac{44.5}{\log_{10} \Delta E^* - 2.55} \right)$$

where

$$\Delta E^* = \sqrt{(100 - L^*)^2 + a^{*2} + b^{*2}}$$

L* is the L* value for the sample calculated for C/2° conditions

a* is the a* value for the sample calculated for C/2° conditions

b* is the b* value for the sample calculated for C/2° conditions.

The implied standard for the DE* calculation is the top-of-scale standardization to a 100-mm cell filled with dodecane. An adjustment is also made for calculating this value using a 50-mm cell rather than a 100-mm cell.

For values greater than 30, 30 is displayed. For values less than 16, 16 is displayed.

When the Saybolt function is optimized, the following equation is used:

$$\text{Saybolt}^* = \alpha + \left(\frac{\beta}{\log_{10} \Delta E^* - \theta} \right)$$

where

ΔE^* is as above

α is the intercept correction constant entered by the user

β is the slope correction constant entered by the user

θ is the correction constant entered by the user.

To obtain Saybolt values, complete the following steps.

1. Standardize the instrument in a transmission mode.
2. Select Saybolt as an index for display in the Color Data Table.
3. Two columns will be added to the color data table. The first column gives the calculated value for the index and the second column indicates "Dil" if the specimen read was diluted.
4. To edit the scale constants, choose **Configure Scales** from the **Options** menu and **SAYBOLT-50/100mm** from the submenu. Edit the constants and whether dilution was used.
5. The column header is displayed with a trailing asterisk (*) if custom constants are in use.
6. Read the sample using a 50-mm transmission cell.

When Saybolt data is recalled, the dilution indication will be correctly displayed and the index value will be recalculated based on the current constants.

Saybolt Difference is also available, and is defined as follows:

$$\text{dSaybolt-50/100 mm} = (\text{Saybolt-50/100 mm})_{\text{sample}} - (\text{Saybolt-50/100 mm})_{\text{standard.}}$$

Tint Indices

Three tint indices are available in EasyMatch QC as defined below. These indices are available only when the instrument is standardized in a reflectance mode.

CIE Tint and ASTM E313 Tint are calculated using the same equation, given below, but are available for different illuminant/observer combinations, as described below. Refer to *CIE Publication 15.2*, "Colorimetry," for more information on CIE Tint. Refer to *ASTM E313*, "Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates," for more information on ASTM E313 Tint.

$$\text{Tint E313} = T_x\,(x_n - x) - 650\,(y_n - y) = \text{Tint CIE}$$

where x and y are the chromaticity coordinates of the specimen and x_n and y_n are the chromaticity coordinates for the CIE standard illuminant and source used. These values are provided in the table below based on the illuminant and observer used. The T_x coefficient is also given in the table. CIE Tint is available for the D65/10°, D65/2°, and C/2° illuminant/observer combinations. ASTM E313 Tint is available for illuminants C, D50, and D65 and the 2° and 10° standard observers. A blank cell is received when any other illuminant/observer combination is in use.

Value	C/2°	D50/2°	D65/2°	C/10°	D50/10°	D65/10°
T_x	1000	1000	1000	900	900	900
x_n	0.3101	0.3457	0.3127	0.3104	0.3477	0.3138
y_n	0.3161	0.3585	0.3290	0.3191	0.3595	0.3310

Tint CIE Difference and Tint E313 Difference are also available, and are defined as follows:

$$\text{dTint CIE} = (\text{Tint CIE})_{\text{sample}} - (\text{Tint CIE})_{\text{standard}},$$

$$\text{dTint E313} = (\text{Tint E313})_{\text{sample}} - (\text{Tint E313})_{\text{standard}}.$$

Tint GANZ = mx + ny + k

where

$$m = \frac{-\cos(\alpha)}{BW} = -937.588$$

$$n = \frac{\sin(\alpha)}{BW} = 826.697$$

$$k = -m\bar{x} - n\bar{y} = 21.352$$

x and y are the CIE chromaticity coordinates.

α is the angle, in chromaticity space, between the x chromaticity axis and the line that joins the chromaticity coordinates measured for the lowest and highest whiteness steps of the 4-step cotton white scale. Its value depends on the exact illumination conditions of the instrument.

Note: Only the ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, and UltraScan VIS instruments with the UV control option installed may correctly calculate Ganz Tint.

Tint GANZ Difference is also available, and is defined as follows:

$$dTint\ GANZ = (Tint\ GANZ)_{sample} - (Tint\ GANZ)_{standard.}$$

A few caveats regarding measurement of tint:

- The application of this equation is restricted to samples that are called "white" commercially, that are similar in color and fluorescence, and that are measured on the same instrument at the same time. Under these conditions, their use should give relative, but not absolute, evaluations of tint that are adequate for commercial use.
- The more positive the value of tint, the greater is the indicated greenish tint of the sample. The more negative the value of tint, the greater is its reddish tint. Lines of equal tint are approximately parallel to the line of dominant wavelength 466 nm. For perfect white, tint = 0.
- Equal differences in tint do not always represent equal perceptual differences in tint.
- This equation should only be used for samples having tint values between -3 and +3.

USP 10-mm and USP 20-mm (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan PRO, UltraScan XE, and UltraScan VIS only)

USP (United States Pharmacopeia Color) is a visual liquid color index used in the pharmaceutical industry. It consists of three primary color standard solutions (cobaltous chloride, ferric chloride, and cupric sulfate) that are combined with water to produce fifteen reference USP liquid color standards labeled A-T.

A HunterLab spectrophotometer standardized in a transmission mode may be used to instrumentally determine the closest USP standard to any sample solution read. Samples should be measured using a 10-mm or 20-mm path length transmission cell, choosing the matching version of the USP index for display. The USP standard value (or "Water" if the sample is closest to water white) is then reported.

Refer to U.S. Pharmacopeia Monograph 631, "Color and Achromicity," for more information.

Whiteness Indices

Whiteness is associated with a region or volume in color space in which objects are recognized as white. Degree of whiteness is measured by the degree of departure of the object from a perfect white.

Whiteness Index per CIE is equivalent to the whiteness index published in **ASTM Method E313**.

$$WI\ CIE = Y + 800\ (x_n - x) + 1700\ (y_n - y) = WI\ E313$$

where Y, x, y are the luminance factor and chromaticity coordinates of the specimen, and x_n and y_n are the chromaticity coordinates for the CIE standard illuminant and source used. These values are provided in the table below based on the illuminant and observer used. Whiteness Index can only be calculated for illuminants C, D50, and D65. A blank cell is received when any other illuminant is in use.

Value	**C/2°**	**D50/2°**	**D65/2°**	**C/10°**	**D50/10°**	**D65/10°**
x_n	0.3101	0.3457	0.3127	0.3104	0.3477	0.3138
y_n	0.3161	0.3585	0.3290	0.3191	0.3595	0.3310

Refer to ASTM Method E313, "Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates," for more information.

Whiteness Index per the CIE Colorimetry Committee (displayed as Whiteness Index CIE) is the same as the current ASTM E313 whiteness described above, but may only be calculated and displayed for D65/2°, D65/10°, and C/2°. The CIE method on which this index is based is equivalent to AATCC Test Method 110: Whiteness of Textiles.

WI CIE Difference and WI E313 Difference are also available, and are defined as follows:

$$dWI\ CIE = (WI\ CIE)_{sample} - (WI\ CIE)_{standard,}$$

$$dWI\ E313 = (WI\ E313)_{sample} - (WI\ E313)_{standard.}$$

Spectral reflectance can vary based on the geometry of the instrument used, the exact properties of the illuminant simulated (usually D65), and the condition of the instrument's lamp. This can be a problem, especially for measurement of fluorescent samples, where maintenance of a constant illuminant spectral energy distribution is imperative. The main purpose in creating the **Ganz Whiteness Index** was to allow constant, comparable results for whiteness and tint of fluorescent materials, even by using instruments of different designs and different illuminant simulation.

$$WI\ GANZ = DY + Px + Qy + C \text{ for D65/10°}$$

where

$$D = \frac{\delta W}{\delta Y} = 1$$

$$P = \left(\frac{-\delta W}{\delta S}\right) * \left(\frac{\cos(\varphi + \eta)}{\cos(\varphi)}\right) = -1868.322 \text{ for UltraScan XE}$$

= a similar value, optimized for each individual instrument for ColorQuest XE, LabScan XE, UltraScan PRO, and UltraScan VIS

$$Q = \left(\frac{\delta W}{\delta S}\right) * \left(\frac{\sin(\varphi + \pi)}{\cos(\varphi)}\right)$$ = -3695.690 for UltraScan XE

= a similar value, optimized for each individual instrument for ColorQuest XE, LabScan XE, UltraScan PRO, and UltraScan VIS

$$C = \left[W_0 * \left(1 - \frac{\delta W}{\delta Y}\right)\right] - \left(P_{X_n}\right) - \left(Q_{y_n}\right)$$ = 1809.441 for UltraScan XE

= a similar value, optimized for each individual instrument for ColorQuest XE, LabScan XE, UltraScan PRO, and UltraScan VIS.

Y, x, and y are the CIE Chromaticity Coordinates

φ = the hue preference in reference to the perpendicular to the reference dominant wavelength (RWL) = 15°

η = the angle between the RWL and the x-axis of the chromaticity chart = 48.18154°

$\frac{\delta W}{\delta Y} = 1$ = contribution of lightness to whiteness

$\frac{\delta W}{\delta S} = 4000$ = contribution of saturation to whiteness

W_0 = 100 = degree of whiteness of physical ideal white

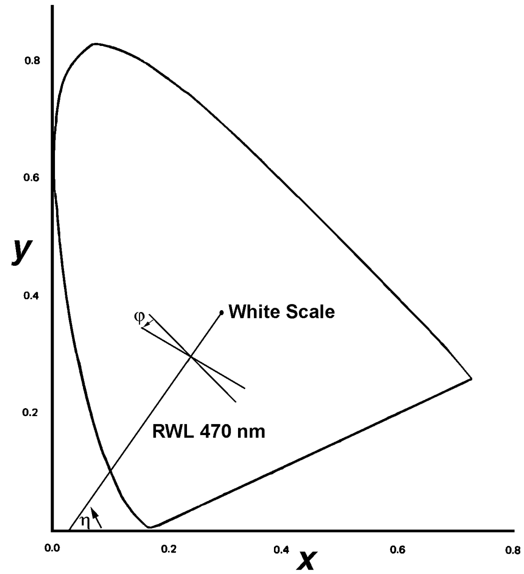
$$x_n = \frac{X_n}{(X_n + Y_n + Z_n)} = 0.313795$$

$$y_n = \frac{Y_n}{(X_n + Y_n + Z_n)} = 0.330972$$

X_n = 94.81 (for D65/10°)

Y_n = 100 (for D65/10°)

Z_n = 107.33 (for D65/10°).



Note: Only the ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, and UltraScan VIS instruments with the UV control option installed may correctly calculate Ganz Whiteness.

Information from Griesser, Rolf, "Assessment of Whiteness and Tint of Fluorescent Substrates with Good Interinstrument Correlation," *Color Research and Application*, Vol. 19, 1994.

WI GANZ Difference is also available, and is defined as follows:

$$dWI\ GANZ = (WI\ GANZ)_{sample} - (WI\ GANZ)_{standard.}$$

Y Brightness

Y brightness is the Y value from the CIE XYZ color scale.

Y Brightness Difference is also available, and is defined as follows:

$$dY\ Brightness = (Y\ Brightness)_{sample} - (Y\ Brightness)_{standard.}$$

Yellowness Indices

Visually, yellowness is associated with scorching, soiling, and general product degradation by light, chemical exposure, and processing. Yellowness indices are used chiefly to measure these types of degradation.

Yellowness Index per ASTM Method E313 is calculated as follows:

$$YI\ E313 = \frac{100\left(C_x X - C_Z Z\right)}{Y}$$

where X, Y, and Z are the CIE Tristimulus values and the coefficients depend on the illuminant and observer as indicated in the table below. Yellowness Index may only be calculated for illuminants D65 and C. A blank cell is received when any other illuminant is in use.

Coefficient	C/2°	D65/2°	C/10°	D65/10°
C_X	1.2769	1.2985	1.2871	1.3013
C_Z	1.0592	1.1335	1.0781	1.1498

YI E313 Difference is also available, and is defined as follows:

$$dYI\ E313 = (YI\ E313)_{sample} - (YI\ E313)_{standard.}$$

Yellowness Index per ASTM Method D1925 is calculated by the software as follows:

$$YI\ D1925 = \frac{100\left(1.274976795X - 1.058398178\,Z\right)}{Y}$$ under C/2° conditions for all instruments except UltraScan XE.

$$YI\ D1925 = \frac{100\left(1.274641506X - 1.057434092\,Z\right)}{Y}$$ under C/2° conditions for UltraScan XE.

The yellowness index formula is shown in ASTM D1925 as:

$$YI\ D1925 = \frac{100\left(1.28\,X_{CIE} - 1.06\,Z_{CIE}\right)}{Y_{CIE}}$$ under C/2° conditions.

The tristimulus values of clear air (for CIE illuminant C and the 1931 CIE 2° standard observer) are X = 98.041, Y = 100.000, Z = 118.103. Using these values, the ASTM formula yields YI = 0.303 for clear air because the factors are truncated to three significant figures. In order to set the yellowness index for air equal to 0.0, the constant multipliers for X_{CIE} and Z_{CIE} have been expanded slightly.

The ASTM D1925 method was withdrawn in 1995, but this formula still provides useful information. This index is always calculated for C/2°, regardless what illuminant and observer are chosen.

YI D1925 Difference is also available, and is defined as follows:

$$dYI\ D1925 = (YI\ D1925)_{sample} - (YI\ D1925)_{standard.}$$

Paper Brightness (Z%)

Paper brightness, Z%, is used in the evaluation of the degradation of white materials. It can also be a measure of the effectiveness of bleaching.

$$Z\% = \frac{100Z_{CIE}}{Z_n}.$$

Z% Difference is also available, and is defined as follows:

$$dZ\% = (Z\%)_{sample} - (Z\%)_{standard.}$$

Read Methods

Haze (ColorQuest XE, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

A transmission haze measurement is a ratio of the diffuse light to the total light transmitted by a specimen. Useful measurements of haze can be made on the HunterLab instruments listed above, although the results do not conform exactly to ASTM method D1003 because of differences in instrument geometry. Haze is calculated as follows:

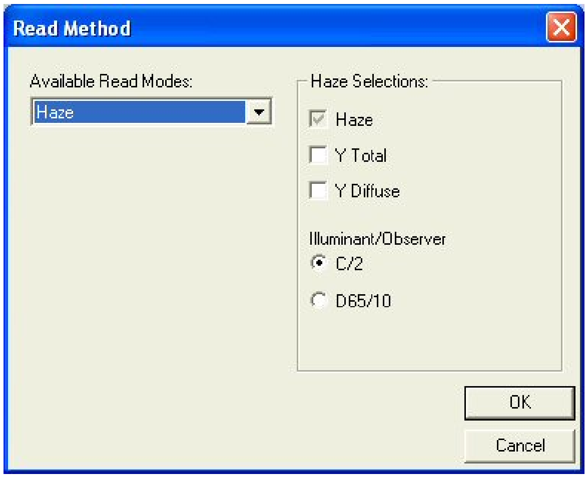
$$\text{Haze} = \frac{Y_{\text{Diffuse Transmission}}}{Y_{\text{Total Transmission}}} \text{ x } 100 .$$

Haze measurements can be made only in a transmission mode on a benchtop sphere instrument (ColorQuest XE, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, or UltraScan VIS).

In order to measure and display haze values, follow the steps outlined below:

1. Select **Read Method** from the **Options** menu.

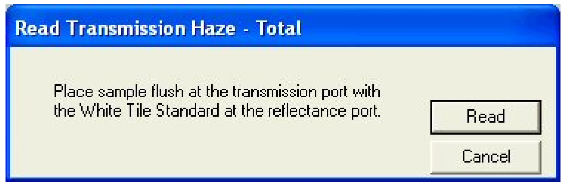
2. Select Haze from the dialog box that appears. The screen changes to allow additional options.



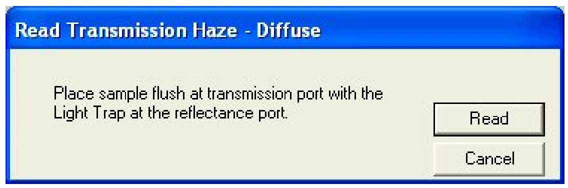
3. Haze is automatically selected for display in your Color Data Table. Check the boxes next to Y Total and/or Y Diffuse to also show these components of the haze calculation. Click the radio button next to the illuminant/observer combination you wish to use. Then click **OK**.

4. Standardize the instrument in TTRAN mode.

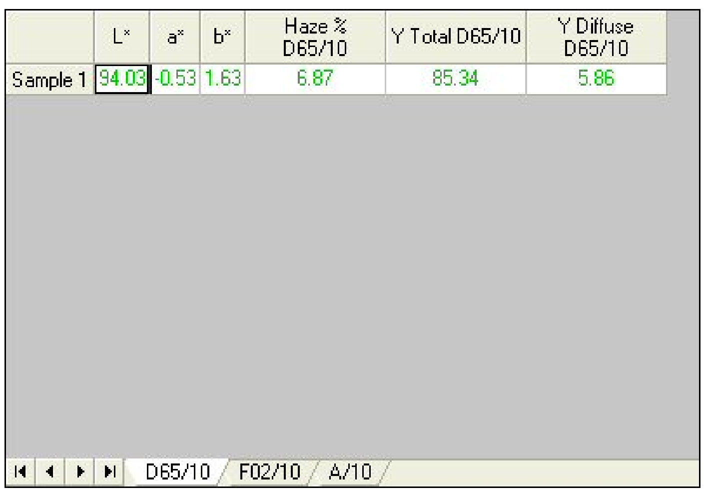
5. Read the standard or sample by choosing **Read Standard** or **Read Sample** from the **Measurements** menu, clicking the **Read Standard** or **Read Sample** button on the toolbar, or pressing **F2** or **F3**. The following prompt appears.



6. Place your sample against the transmission port (the hole in the sphere inside the transmission compartment) and place the white calibration tile at the reflectance port. Click **Read**. The instrument reads and then the following prompt appears.



7. Leave your sample at the transmission port and replace the white calibration tile with the light trap. Click **Read**. The instrument reads. You may be prompted to enter an ID for the measurement as usual. After you do so, Haze and the other parameters you chose to display will be shown in your Color Data Table.



	L*	a*	b*	Haze % D65/10	Y Total D65/10	Y Diffuse D65/10
Sample 1	94.03	-0.53	1.63	6.87	85.34	5.86

Opacity

Note: Opacity may not be measured using a ColorQuest XT.

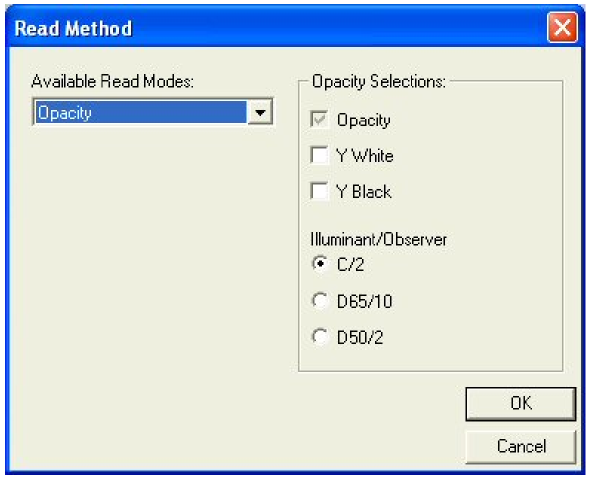
Opacity measurements determine opacity (in reflectance mode) by a contrast ratio measurement. The Y value of the specimen backed by the black glass, non-slip (black) pad for the sample clamp, or light trap is divided by the Y value of the specimen backed by the white tile or white sample clamp insert. The resulting fraction is Y%, or opacity, which is calculated as follows:

$$\text{Opacity} = \frac{Y_{\text{Black Backing}}}{Y_{\text{White Backing}}} \text{ x } 100\,.$$

In order to measure and display opacity values, follow the steps outlined below:

1. Select **Read Method** from the **Options** menu.

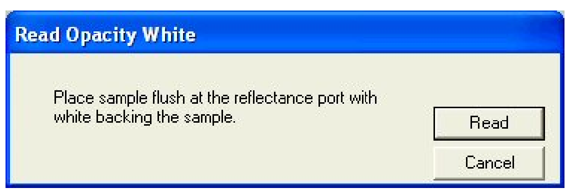
2. Select Opacity from the dialog box that appears. The screen changes to allow additional options.



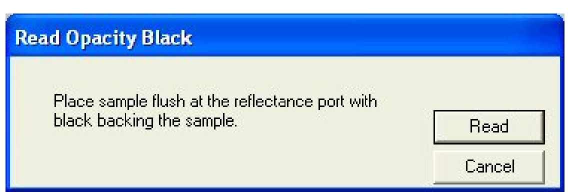
3. Opacity is automatically selected for display in your Color Data Table. Check the boxes next to Y White and/or Y Black to also show these components of the opacity calculation. Click the radio button next to the illuminant/observer combination you wish to use. Then click **OK**.

4. Standardize the instrument. (Use RSIN mode for ColorQuest XE, ColorQuest II Sphere, UltraScan XE, UltraScan PRO, and UltraScan VIS.)

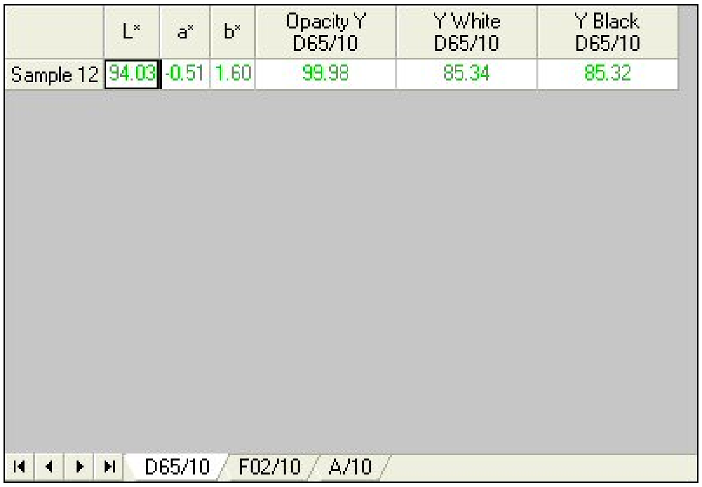
5. Read the standard or sample by choosing **Read Standard** or **Read Sample** from the **Measurements** menu, clicking the **Read Standard** or **Read Sample** button on the toolbar, or pressing **F2** or **F3**. The following prompt appears.



6. Place your sample at the measurement port, backing it with the white standard tile or the white disk of the sample clamp. Click **Read**. The instrument reads and then the following prompt appears.



7. Remove the white backing and place the sample at the measurement port, backing it with the black glass, light trap, or the black non-slip pad of the sample clamp. Click **Read**. The instrument reads. You may be prompted to enter an ID for the measurement as usual. After you do so, Haze and the other parameters you chose to display will be shown in your Color Data Table.



	L*	a*	b*	Opacity Y D65/10	Y White D65/10	Y Black D65/10
Sample 12	94.03	-0.51	1.60	99.98	85.34	85.32

Spectral Data Types

% Strength

Selecting % Strength as a difference data type for display in the Spectral Data Table results in the display of % Strength values for samples as compared to a standard. % Strength is calculated separately for each wavelength displayed, as follows:

$$\%\,\text{Strength} = \frac{K/S_{\text{sample}}}{K/S_{\text{standard}}} * 100 \qquad \text{for reflectance}$$

$$\%\,\text{Strength} = \frac{\text{Absorbance}_{\text{sample}}}{\text{Absorbance}_{\text{standard}}} * 100 \text{ for transmittance.}$$

K/S and Absorbance are described below.

Absorbance (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

Selecting Absorbance as the spectral data type when configuring a Spectral Data Table for an instrument standardized in Total or Regular Transmittance results in the display of absorbance values. Absorbance values are calculated for each wavelength.

$$\text{Absorbance} = -\log_{10}T$$

where T = transmittance.

In the Color Data Table configuration, a wavelength range appropriate for your instrument should be chosen. Do not choose wavelengths above or below the range of your instrument or the results of these calculations may be in error.

K/S

Selecting K/S as the spectral data type when configuring the Spectral Data Table results in the display of K/S values. These values are valid only for measurements made in a reflectance mode. Therefore, they are displayed only when the standardization mode is reflectance.

K/S values for the product standard and sample are calculated for each wavelength. The points of minimum and maximum reflectance of the product standard and sample may be viewed on the Spectral Plot.

$$\frac{K}{S} = \frac{[1 - 0.01\,R]^2}{2[0.01R]}$$

where R = reflectance. Calculating K/S is only appropriate for samples whose minimum % reflectance (at any wavelength) is at least 10%. If the minimum % reflectance is less than 10%, you should dilute the sample before measurement of K/S.

In the Spectral Data Table configuration, a wavelength range appropriate for your instrument should be chosen. Do not choose wavelengths above or below the range of your instrument or the results of these calculations may be in error.

Reflectance

Selecting reflectance spectral data allows the raw reflectance value (%) for each wavelength interval selected in the configuration to be displayed.

Transmission (ColorQuest II Sphere, ColorQuest XE, ColorQuest XT, UltraScan XE, UltraScan PRO, and UltraScan VIS only)

Selecting transmission spectral data allows the raw transmission value (%) for each wavelength interval selected in the configuration to be displayed.

APPENDIX B

Keyboard Shortcuts

Function keys have been assigned to some frequently used items and can be used to speed operation.

New Job	Ctrl + N
Open Job	Ctrl + O
Recall Measurement From Database	Ctrl + R
Save Job	Ctrl + S
Save Job As	Ctrl + A
Save Job Template	Ctrl + J
Apply Template to Job	Ctrl + T
Save Measurement to Database	Ctrl + M
Print Job	Ctrl + P
Cut	Ctrl + X
Copy	Ctrl + C
Paste	Ctrl + V
Return to English	Ctrl + E
Delete	Del
Read Standard	F2
Read Sample	F3
Standardize	F4
Read Series	F5
Help Topics	F1

In addition, the EasyMatch QC menus may be opened using **Alt** + the first letter of the menu name and then the desired menu command may be selected by typing the underlined letter in the name of the command. These shortcuts are outlined below.

Open File Menu	Alt + F
Open Edit Menu	Alt + E
Open View Menu	Alt + V

Open Measurements Menu	Alt + M
Open Options Menu	Alt + O
Open Sensor Menu	Alt + S
Open Window Menu	Alt + W
Open Help Menu	Alt + H

Commands from an Open File Menu:

New Job	N
Open Job	O
Open Job Template	T
Recall Measurement From Database	R
Delete Measurement From Database	D
Close Job	C
Save Job	S
Save Job As	A
Save Job Template	J
Save Job Template As	B
Save Measurement to Database	M
eSignature	E
Print Job Setup	N
Print Job Preview	V
Print Job	P
Printer Setup	U
Email	Job J Template T
Time Synchronization	Y
Database/Backup Database	B
Log Off	L
Open this job	1-4
Exit	X

Commands from an Open Edit Menu:

Cut	T
Copy	C
Paste	P
Delete	D

Commands from an Open View Menu:

Toolbar	T
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APPENDIX C

Software Messages

Occasionally you may receive an error or warning message on your computer screen. A message can help you determine if you have a setup, instrument, or software problem. This appendix lists some of the more prevalent messages for EasyMatch QC. If any error message is displayed which is not described in this chapter, it may be a Windows message. Refer to your Windows User's Guide for a possible explanation. Contact HunterLab Technical Support if the error message cannot be found or the problem persists. Please read "When You Need Assistance," page 12-6, prior to telephoning HunterLab.

Message Text	Meaning	Possible Solution(s)
An error occurred during the move data process.	This message indicates that one or more files are not registering in the system (Windows) registry during the installation process. This generally occurs when you are attempting to install while logged into Windows using an account that does not have administrator privileges.	Cancel the installation and log into Windows using an administrator account, then perform the installation.
Cannot execute the application due to Invalid license. Please contact HunterLab.	You are attempting to open EasyMatch QC with a defective hardware key connected to your computer.	Obtain a new key from HunterLab.
Did not receive a status message from the sensor.	The sensor is not responding to the software's attempt to connect to it.	Follow the instructions on the screen below the message to check the status of the sensor and its connections. If you are connecting to a MiniScan EZ, confirm that the instrument is turned on. If you are connecting to an UltraScan PRO or UltraScan VIS using a USB cable, also consider whether the FTDI USB-to-serial adapter is installed properly. If, after checking and attempting to connect again, this message is still received, contact HunterLab concerning instrument service.

Message Text	Meaning	Possible Solution(s)
Difference data cannot be retrieved from the data log when it is in tristimulus mode.	You are attempting to copy a DIFFERENCE TRISTIMULUS sample from a ColorFlex or MiniScan XE Plus datalog into a job or into the database. The software does not know what standard values were used to calculate the sample's difference data.	Save all data to the ColorFlex or MiniScan XE Plus datalog as SPECTRAL data or ABSOLUTE TRISTIMULUS data.
Failed to detect HunterLab key. Insert and try again.	You are attempting to open EasyMatch QC without the hardware key connected to your computer.	Install the EasyMatch QC key provided with your system onto your computer.
Not an EasyMatch QC key.	You are attempting to open EasyMatch QC with a hardware key connected to your computer that is either not a HunterLab key or is not programmed to allow access to EasyMatch QC.	Install the EasyMatch QC key provided with your system onto your computer.
Standard's standardization mode doesn't match the sample's standardization mode. Sample will not be read.	You are attempting to link a sample read in one mode (i.e., TTRAN 1.00-in with UV filter nominal) to a standard read in another mode (i.e., RSIN 1.00-in with UV filter nominal).	If the mode of the sample is correct, link it to a standard read in that mode. If the mode of the sample is incorrect, standardize the instrument in the proper mode before reading the sample again. Uncheck "Lock Standardization Mode to Job" in Application Preferences.
The job's sensor type and the current sensor type do not match. Standard cannot be read.	The current job is linked to one sensor type (i.e., LabScan XE), but you are trying to make measurements using a sensor of a different type (i.e., Color Quest XE).	Open a job that is linked to the sensor type with which you wish to read. Uncheck "Lock Sensor to Job" in Application Preferences.
You have not yet installed a sensor. Please install a sensor if you wish to take measurements.	You are opening the software for the first time or for the first time after removing all installed sensors.	Use the **Install/Configure** command in the **Sensor** menu to install the desired sensor.
Your license has expired. Please contact HunterLab.	You are attempting to open EasyMatch QC with either a demo or a sales hardware key that has expired connected to your computer.	Obtain an updated key from HunterLab and install it onto your computer.

APPENDIX D

Creating and Configuring a SQL Database

This appendix describes how to create and configure a SQL database for use with EasyMatch QC. A working knowledge of SQL server is recommended for performing these steps. A copy of SQL Server (Microsoft SQL Sever is typical) should be installed first followed by EasyMatch QC, as described in the EasyMatch QC Installation Guide.

1. In SQL Server, select **Open** from the **File** menu and choose to open the C:\Program Files\HunterLab\EasyMatchQC\SQL Database Script\EZMQC.sql script file. This is the location of the file if you installed EasyMatch QC to the default folder. If you installed elsewhere, you will find the SQL Database Script subfolder in your installation folder.

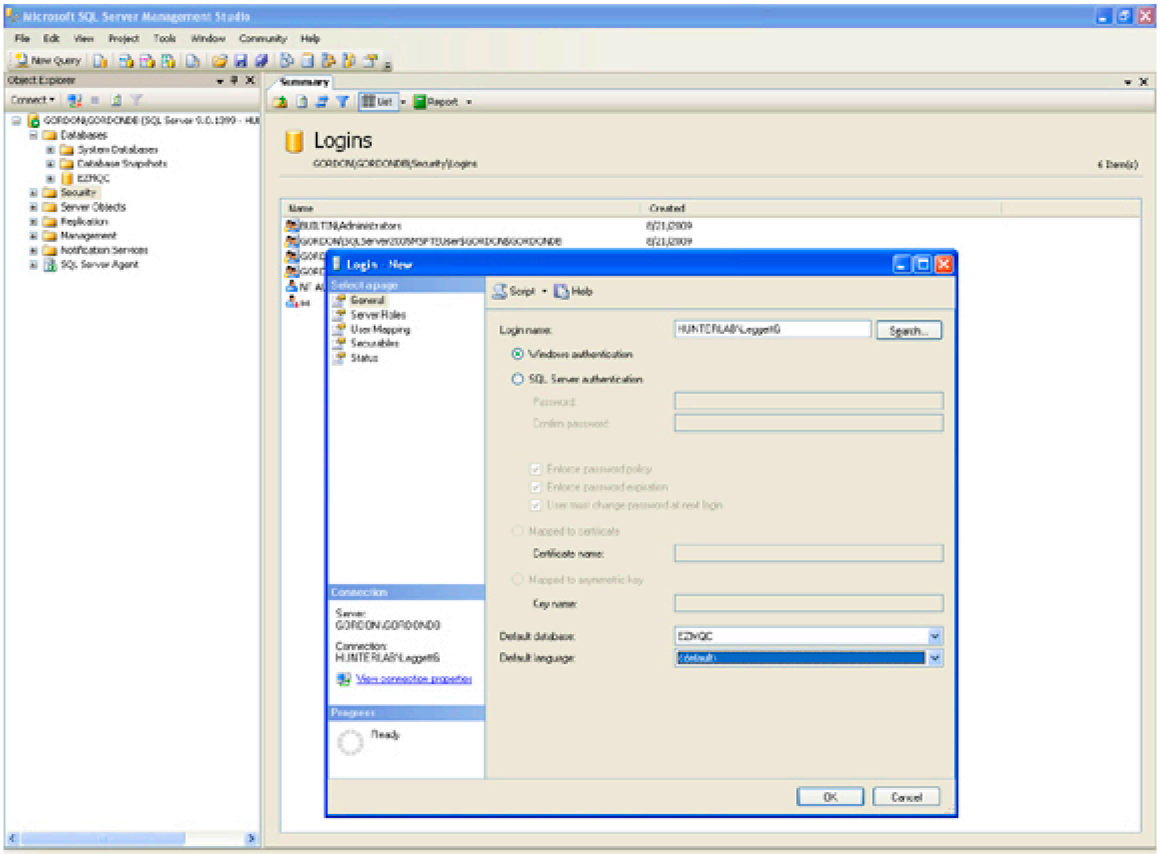
2. Execute the EZMQC.sql script file and the EZMQC SQL database will be created.

3. You can use the SQL Server to view this database and see that tables have been created within it.

4. In the tree view, expand the **Security** branch.

5. Right-click on **Logins** under **Security** and choose **New Login**.

6. Change Default Database to EZMQC and do User Mapping to set each User with data read and write roles for the EZMQC SQL database.

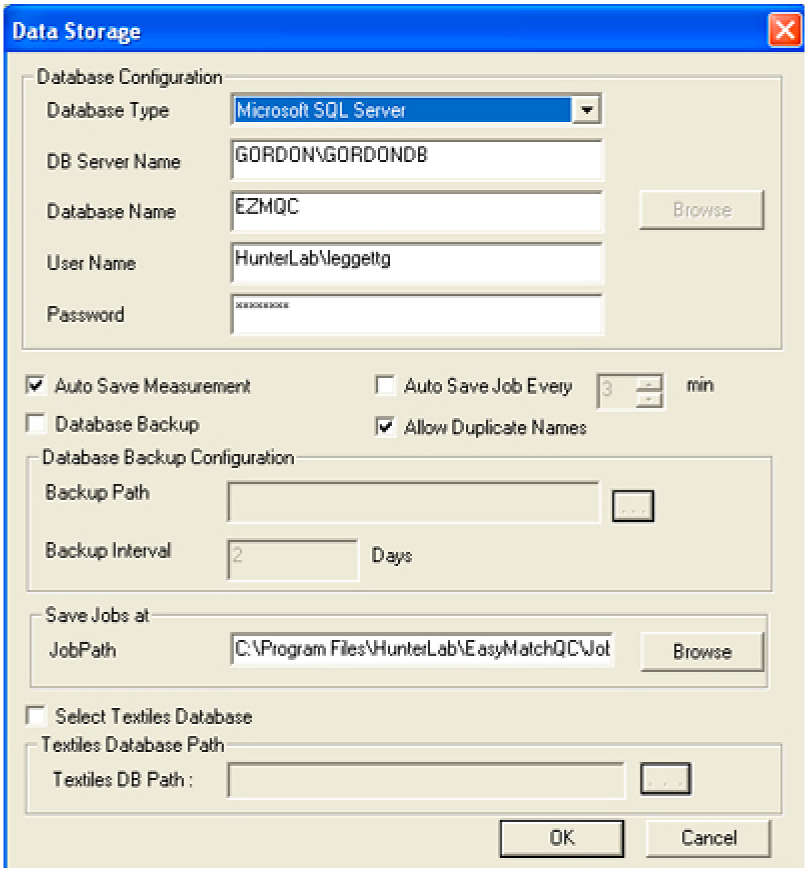


7. Close SQL Server.

8. On the computer where EasyMatch QC will be run, open EasyMatch QC.

9. Select the **Options** menu, **System Configuration**, and then **Data Storage**. The Data Storage Screen appears.

10. Select the SQL Server, enter the server and database name (EZMQC). Click **OK**.



11. Restart EasyMatch QC and the SQL database is ready for use.

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