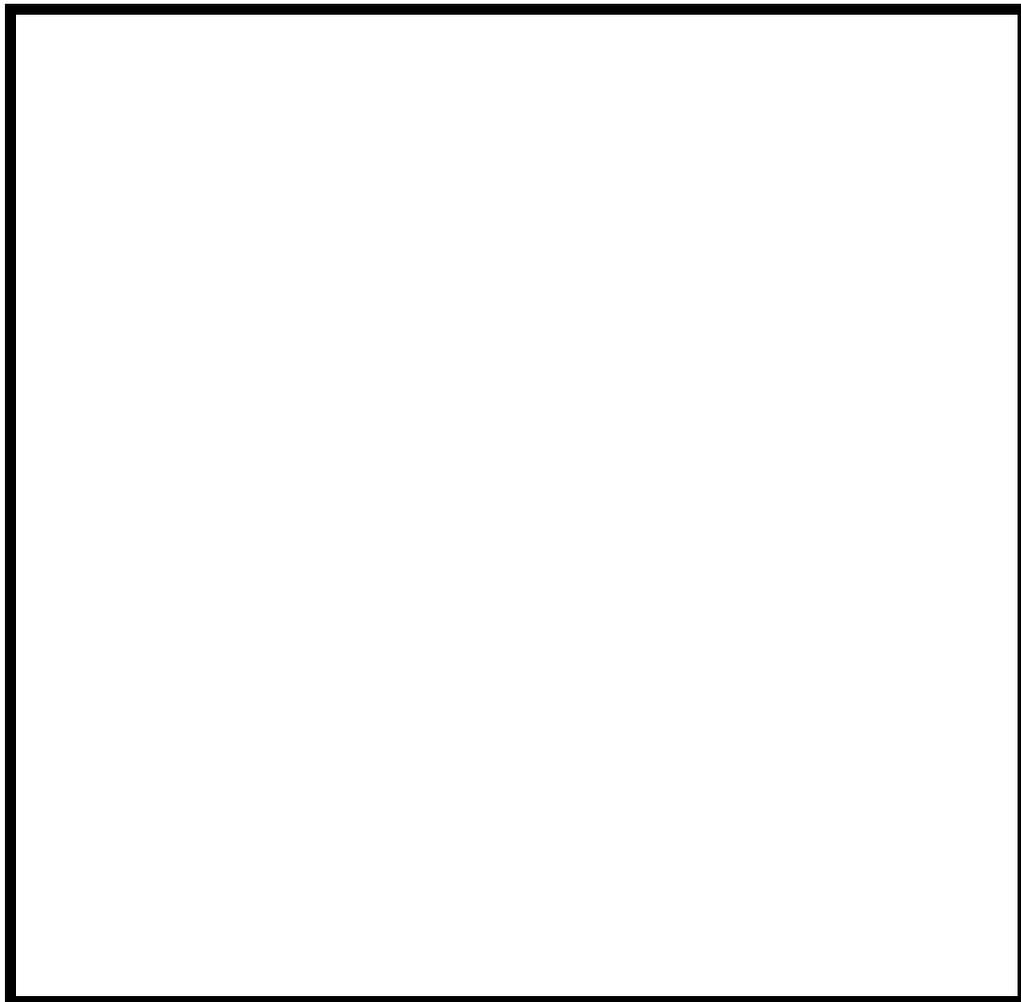# X-Rite® SP78™
Sphere Spectrophotometer

User's Manual

NOTE: Shielded interface cables must be used in order to maintain compliance with the desired FCC and European emission requirements.

WARNING: This instrument is not for use in explosive environment.

WARNUNG: Das Gerät soll in einer explosiven Umgebung NICHT verwendet werden.

ADVERTENCIA - NO use este aparato en los ambientes explosivos.

ATTENTION: Cet instrument NE DOIT PAS être utilisé dans un environnement explosif.

AVVERTIMENTO - NON usare questo apparecchio in ambienti esplosivi.

CAUTION: Operational hazard exists if battery charger other than X-Rite SE30-61 (115V) or SE30-62 (230V) is used. Use only X-Rite battery pack MA58-05, other types may burst causing personal injury.

VORSICHT: Es besteht Betriebsgefahr bei der Verwendung von einem Adapter außer X-Rite SE30-61 (115 U) oder SE30-62 (230 U). Verwenden Sie nur den X-Rite Akkupack MA58-05, mit anderen Akkus läuft die Gefahr von Explosion und Verletzung.

ADVERTENCIA: No use otro cargador de las pilas que no sea la pieza X-Rite SE30-61 (115V) o SE30-62 (230V), por el riesgo de mal funcionamiento del equipo. Use solamente las pilas MA58-05 de X-Rite, es posible que los otros tipos puedan estallar y causar daños corporales.

ATTENTION: Ne pas utiliser d'adaptateur autre que SE30-61 (115V) ou SE30-62 (230V) de X-Rite au risque de mauvais fonctionnement de l'appareil. Utiliser seulement le bloc de batteries MA58-05 de X-Rite, il y a danger d'explosion et de blessures avec les autres types.

AVVERTENZA: Non usare un altro caricabatterie che non è del pezzo X-Rite X-Rite SE30-61 (115V) o SE30-62 (230V), per il rischio di malfunzionamento dell'apparecchio. Usare solamente gli accumulatori MA58-05 di X-Rite, è possibile che altri tipi possano scoppiare e causare danno personale.

Dear Customer:

Congratulations! We at X-Rite, Incorporated are proud to present you with an X-Rite SP78 Sphere Spectrophotometer. This instrument represents the very latest in microcontrollers, integrated circuits, fiber optics, and display technologies. As a result, your X-Rite SP78 is a rugged and reliable instrument whose performance and design exhibit the qualities of a finely engineered instrument, which is not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. As always, X-Rite stands behind your unit with a one year limited warranty, and a dedicated service organization. If the need arises, please don't hesitate to call us.

Thank you for your trust and confidence.

Ted Thompson
Chairman and CEO

Proprietary Notice

The information contained in this manual is derived from patent and proprietary data of X-Rite, Incorporated. This manual has been prepared expressly for the purpose of assisting in the use and general maintenance of this instrument.

Publication of this information does not imply any rights to reproduce or use this manual for purposes other than installing, operating, or maintaining this instrument. No part of this manual may be reproduced, transcribed, transmitted, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, electronic, magnetic, mechanical, optical, manual, or otherwise, without the prior written permission of an officer of X-Rite, Incorporated.

These provisions are intended to state all of the rights and responsibilities between X-Rite, Incorporated and the customer. They supersede all warranties, expressed or implied, and whether of merchantability, fitness or otherwise. The remedies contained in this manual are exclusive. Customer and X-Rite, Incorporated waive all other remedies, including but not limited to consequential damages. This product covered by one or more of the following U.S. Patents:

5,400,138

Other patents pending. Foreign patent numbers provided on request.

Limited Warranty

   X-Rite, Incorporated warrants each unit manufactured to be free of defects in material and workmanship (excluding battery pack) for a period of twelve months. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested. The unit shall be returned with transportation charges prepaid.

   THERE ARE NO WARRANTIES OF MERCHANTABILITY OR FITNESS. THIS WARRANTY OBLIGATION IS LIMITED TO SERVICING THE UNIT RETURNED TO X-RITE, INCORPORATED or AN AUTHORIZED SERVICE DEALER FOR THAT PURPOSE.

   X-Rite, Incorporated offers a repair program for instruments out of warranty. For more information, refer to X-Rite Instrument Services Department.

   Always include serial number in any correspondence concerning the unit. The serial number is located on the bottom of the instrument.

   This agreement shall be interpreted in accordance with the laws of the State of Michigan and jurisdiction and venue shall lie with the courts of Michigan as selected by X-Rite, Incorporated.

   CAUTION: This instrument is not for use in explosive environments.

Table of Contents

General Description

The X-Rite SP78 is a portable sphere spectrophotometer designed to give fast, precise, and accurate color measurement information on any surface - smooth to textured on a number of different materials - including paper, paint, plastic, and textiles.

The SP78 will store up to 50 user defined setups. Each setup consists of a tolerancing method, tolerancing limits, reference measurement, and 555 shade sort options (shade size and range).

The SP78 uses a dual beam optics system which ensures long-term stability, accuracy, and reliability of measurements. The pulsed tungsten lamp provides a reliable and consistent light source which has a very long life and prevents heat build-up.

To determine the influence of the specular component, the SP78 automatically provides both specular-included and specular-excluded data.

Operating Keys (4)

4 x 20 Character Display

AC Adaptor / Charger Jack

Target Window

RS-232 Port

Instrument Shoe

Battery Power ON/OFF Button

Serial Number Label (bottom of instrument)

Battery Access Door
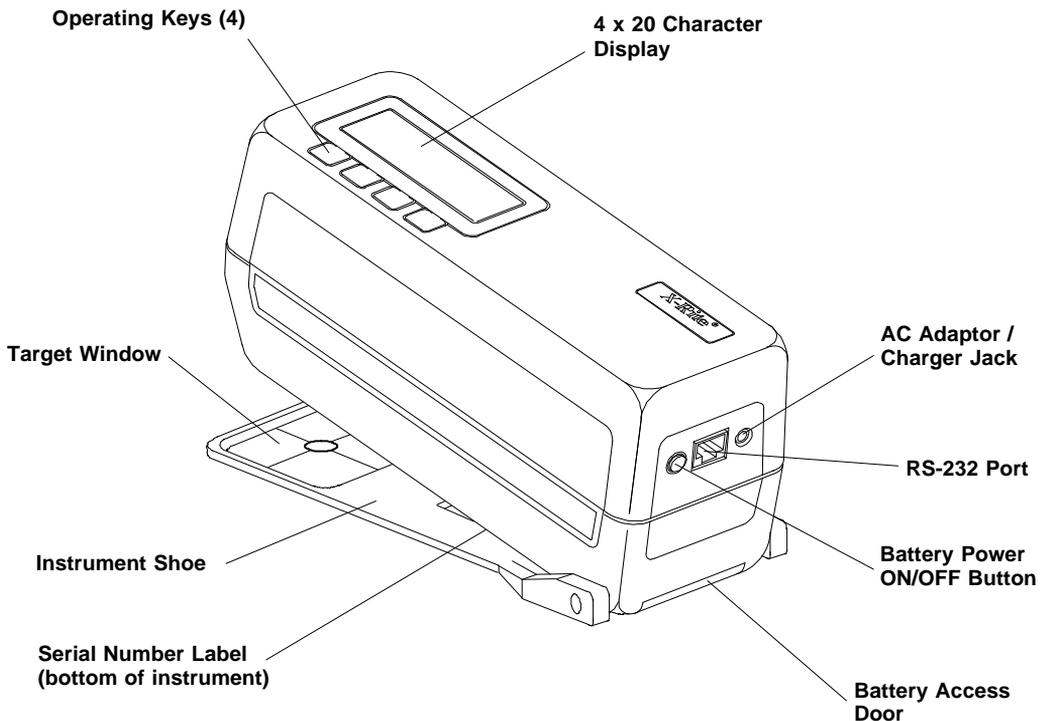
User Interface

This information will familiarize you with the typographical conventions, display function, and general terms used in this manual.

* In the text portion of this manual the SP78 key names are shown with brackets on both sides and in boldface (e.g., **[cnfg]**, etc.). When this is not applicable, the key switch will be shown as a number with quotation marks (e.g., **"Key #1"**, etc.). Switches are numbered from left-to-right.

---

* When a key is momentarily depressed, the word "press" will be used (e.g., Press **[cal]** or Press **"Key #2"**).

---

* Information that will appear in the display window will be shown with quotation marks on each side and in boldface (e.g., **"MEASURE REFERENCE SAMPLE"**).

```
          MEASURE
     REFERENCE SAMPLE
```

Key#1   Key#2   Key#3   Key#4

---
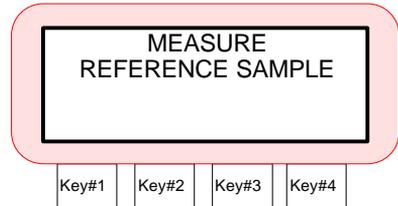
* A "hand" indicates important notes and possible operations that need to be performed before the normal operation.

---

* When a procedure is continued on the next page, an "arrow" will appear in the bottom right hand corner of the page.

What To Do First!

This manual is organized into nine sections and four appendixes. In order to make the best use of your instrument, you are urged to read all nine sections. The appendixes can be referred to as necessary.

Section 1 - shows what the packaging contains and explains how to unlock/lock the shoe, install battery pack, apply power, and charge the batteries properly.

Section 2 - illustrates the proper positioning required for the instrument to obtain accurate and repeatable measurements.

Section 3 - describes the key switches and display, and explains the normal operating functions of the instrument (e.g., color space and illuminant/observer selection, reference and sample measurements and averaging).

Section 4 - explains the QC functions of the instrument which includes defining setups, measuring a reference, and taking pass/fail and 555 shade tag measurements.

Section 5 - describes the procedure for storing measurements and then printing the data. Defines a Run Job operation when interfaced to a computer using X-Rite's QA-Master® software package.

Section 6 - explains all the necessary steps required for calibrating your instrument.

Section 7 - shows the different configuration options and how to set them for your particular requirements. The system configuration should be set prior to taking any measurements.

Section 8 - covers basic maintenance and troubleshooting. Read through this section and see what it contains, then refer to it as required.

Section 9 - explains how to attach the optional bar code reader to the instrument and the proper procedure for scanning bar codes.

Appendix A - lists the technical specifications of the instrument.

Appendix B - lists error messages that may occur during operation or calibration and the proper action to take.

Appendix C - lists optional accessories available from X-Rite or an Authorized Service Center.

Appendix D - describes the color check procedure used to track color measurement performance.

Subjects covered in Section 1 are:

* 1.1 Unpacking and Inspection

* 1.2 Unlocking and Locking the Shoe

* 1.3 Installing the Battery Pack

* 1.4 Applying Power

* 1.5 Charging the Battery Pack

1.1 UNPACKING AND INSPECTION

After removing the instrument from the shipping carton, inspect for possible damage. If any damage is noted, contact the transportation company immediately. Do nothing more until the carrier's agent has inspected the damage.

If damage is not evident, check and make sure that all items are included (refer to the parts list below and the following page for packaging illustration).

Your unit was packaged in a specially designed carton to assure against damage. If reshipment is necessary, the instrument should be packaged in the original carton. If the original carton is not available, a new one can be obtained from X-Rite Inc.

ITEM	QTY SP78	QTY SP78X	QTY SP78L	QTY SP78LX	QTY SP78S	QTY SP78SX	PART NUMBER	DESCRIPTION
20	1	1	1	1	1	1	SD01-41	CERTIFICATE OF CALIBRATION
19	1	1	1	1	1	1	SP68-513	BATTERY REPLACEMENT INSTRUCTIONS
18	1	-	1	-	1	-	SD43-22	U.L. LISTING LABEL
17	1	1	1	1	1	1	SD65-10	PLASTIC BAG
16	2	2	2	2	2	2	SD65-03	PLASTIC BAG
15	2	2	2	2	2	2	SD65-13	PLASTIC BAG
14	-	-	-	-	-	-		
13	1	1	1	1	1	1	SD43-SP68-62	REFLECTANCE LABEL
12	1	1	1	1	1	1	SP68-511	IMPORTANT NOTICE
11	1	1	1	1	1	1	SD01-04	WARRANTY REGISTRATION
10	1	1	1	1	1	1	SP78-500	OPERATION MANUAL
9	1	1	1	1	1	1	SD68-10	ENVELOPE
8	-	-	-	-	1	1	SP78S-00-01	SPHERE SPECTROPHOTOMETER ASSY, 4mm
	-	-	1	1	-	-	SP78L-00-01	SPHERE SPECTROPHOTOMETER ASSY, 14mm
	1	1	-	-	-	-	SP78-00-01	SPHERE SPECTROPHOTOMETER ASSY, 8mm
7	1	1	1	1	1	1	SP68-105-01	BLACK TRAP ASSEMBLY
6	1	1	1	1	1	1	SP68-62	REFLECTION STANDARD ASSY
5	-	1	-	1	-	1	SE30-62	AC/DC ADAPTOR 230 VAC, 50/60 Hz
4	1	-	1	-	1	-	SE30-61	AC/DC ADAPTOR 115 VAC, 50/60 Hz
3	1	1	1	1	1	1	SD67-06-01	INSTRUMENT CASE
2	4	4	4	4	4	4	SD200-MA58-02	CORNER PAD
1	1	1	1	1	1	1	SD200-MA58-01	CARTON

PARTS LIST

Packaging Illustration

PART OF ITEM 8

NOT USED WITH
115 VAC VERSION

NOT USED WITH
230 VAC VERSION

1.2 Unlocking and Locking the Shoe

The instrument is shipped from the factory with the shoe in the locked position. The shoe should always be locked next to the instrument when it is stored.

To Unlock Shoe:

1. Hold shoe **[1]** against instrument.
2. Slide lock button **[2]** on bottom of unit towards the front until it stops, then slowly release the shoe **[1].**

To Lock Shoe:

1. Hold shoe **[1]** against unit.
2. Slide lock button **[2]** towards the back of unit until is stops, then release shoe.
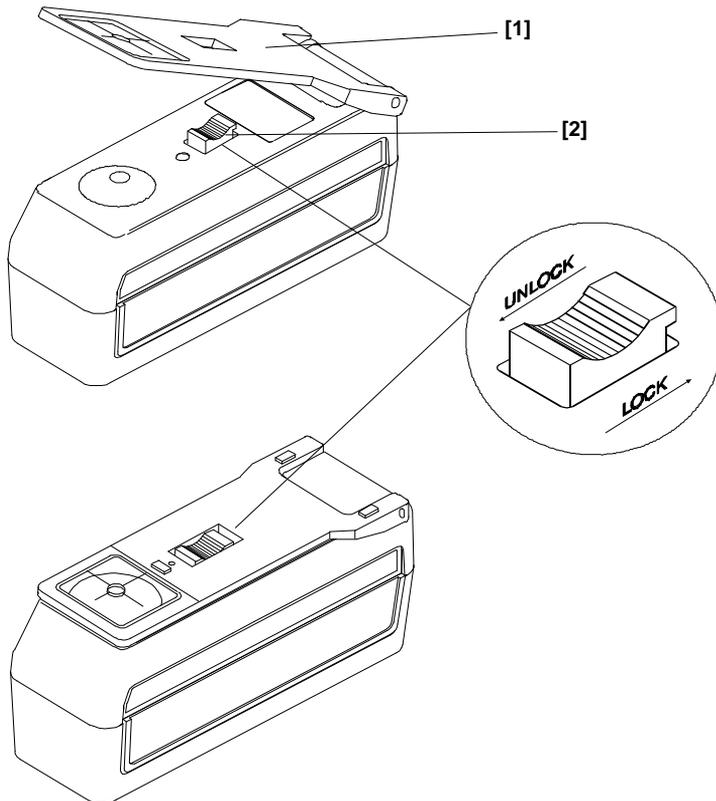
1.3 Installing Battery Pack

The instrument is shipped from the factory with the battery pack removed. The battey pack is located in the instrument case and ***must be*** installed before the instrument is used.

To Install Battery Pack:

1. Carefully place instrument on it's top and lock shoe if not locked.

2. Remove battery access cover by sliding towards rear of unit.

3. Slide battery pack into unit (with connector end down) until properly seated. Refer to illustration.

4. Reinstall battery access cover by sliding into position.

5. Refer to Section 1.5 for battery charging information.

Battery Pack

Access Cover

Connector

Lock Shoe
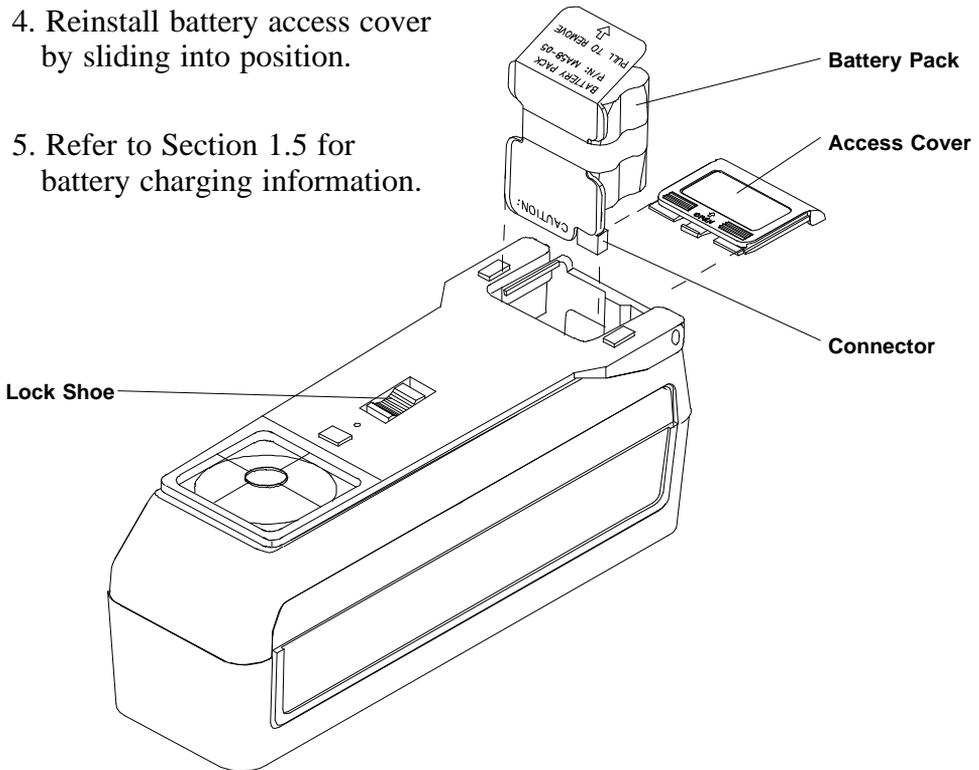
1.4 APPLYING POWER

Battery Operation

The SP78 is activated during battery operation by pressing the "Power On/Off" switch located on the rear of the instrument. The unit will automatically turn off after 45 seconds of non-operation.

If the SP78 is allowed to power down after 45 seconds, simply taking a measurement or pressing any key will reactivate the unit. The SP78 will always wakeup in the same operation function (e.g., L*a*b*, L*C*h°, etc.) as when it powered down. The instrument can also be turned off by pressing the power On/Off switch on the rear of the unit. The switch should always be used to turn off the unit when it is going to be stored. This will prevent any inadvertent measurement from being taken.
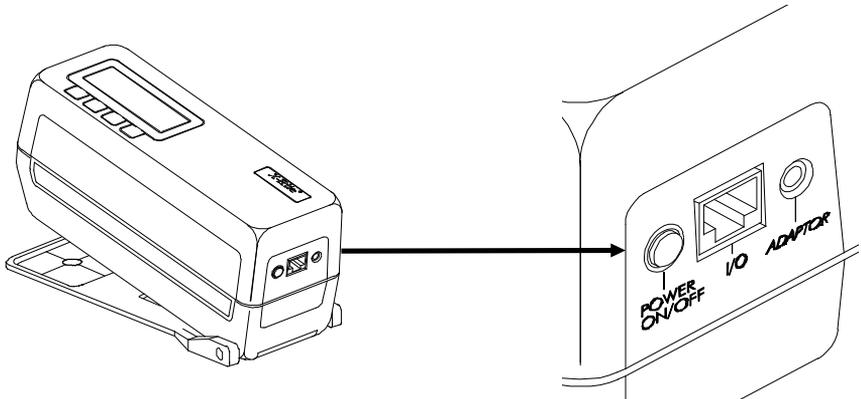
AC Operation

☞ The battery pack must be installed before plugging in the AC adaptor (refer to Section 1.3).

As long as the AC adaptor is connected to the instrument, the SP78 will remain on. The power on/off switch will act as a reset and return the instrument to its main mode.
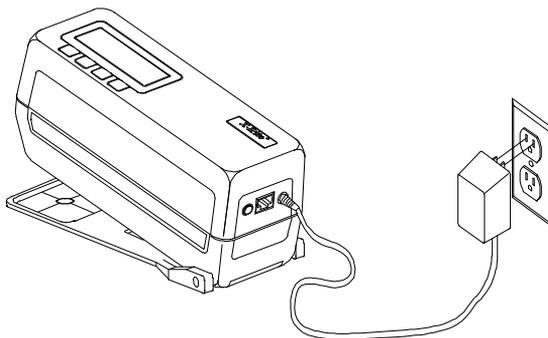
1.4 CHARGING THE BATTERY PACK

"The Battery Pack In The Instrument Must Be Charged Before Use!"

The SP78 is powered by six nickel-metal hydride batteries in a removable battery pack. The battery pack must remain in the instrument for proper operation. The AC adaptor charges the batteries when it is plugged in, but does not eliminate the need for the batteries.

The SP78 can be operated while the batteries are being charged. Before plugging in the AC adaptor, make sure that the voltage indicated on the adaptor complies with the AC line voltage in your area. If not, contact X-Rite or your Authorized Representative.

The instrument battery pack should be fully charged (100%) in 16 hours and should provide over 500 measurements. Charging the battery pack for less than 16 hours will reduce the operating time of the unit (see charging tips).

Charging Tips

* The instrument features a "fast charge" cycle which will charge a fully discharged battery pack to 50% capacity in 4 hours. A 100% charge will be restored to a fully discharged pack in 16 hours.

* A "Battery Low" message will appear on the display when there are approximately 50 measurements left. The charger should be plugged in as soon as possible when the message appears. A "Batteries Very Low - Must Be Charged" message will appear when there is insufficient charge to operate the instrument. Once this message appears, the charger must be connected before any more measurements can be taken.

* The removable battery pack is equipped with a built-in charger jack for external charging. This allows an additional pack to be charged while one is in use in the instrument. A fully discharged pack will be completely charged in 16 hours.

* If the instrument is to be stored for an extended period of time (over 6 months), the battery pack should be removed from the unit.

NOTE: Do not plug the AC adaptor into the instrument without a battery pack installed. The instrument will not function with the battery pack out.

$\Rightarrow$

AC Adaptor Connection Procedure

1. Plug the small connector end of the AC adaptor into the adaptor jack on the back of the instrument or the battery pack.

2. Plug the adaptor into the AC wall outlet.

Adaptor Jack

Small Connector

AC Wall Outlet

Adaptor

Instrument Charging

Battery Pack Charging

AC Wall Outlet

Adaptor Jack

Small Connector

Adaptor
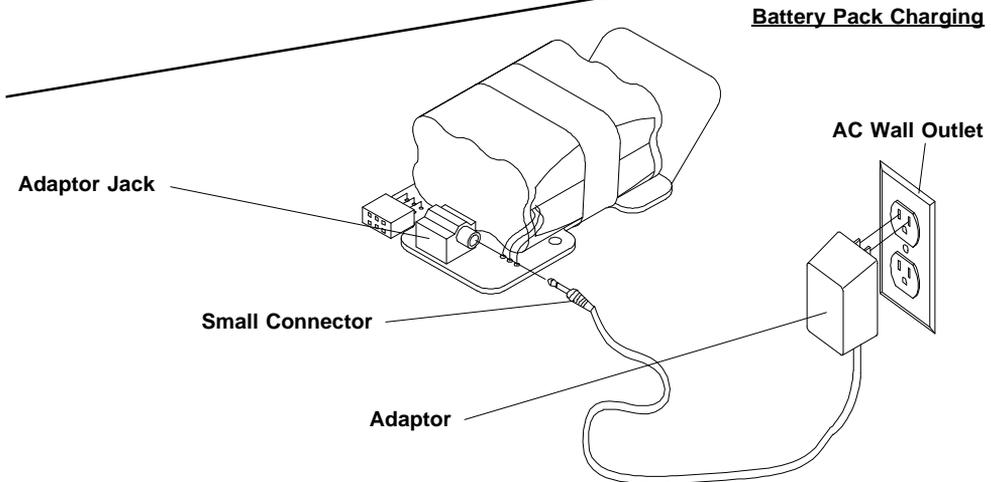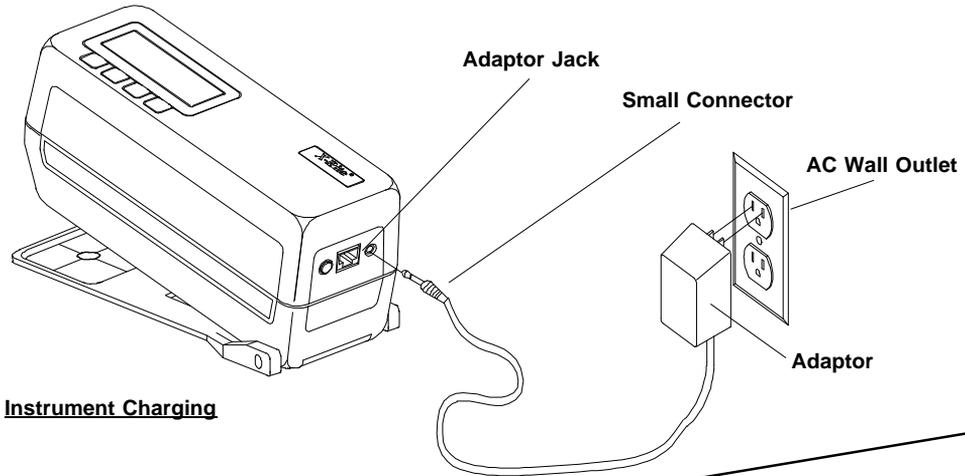
☞ The unit will not lose any of the preset information (i.e., cal, setups, etc.) if the battery pack is removed. Refer to Battery Pack Replacement in Section 8 for proper removal and installation.

SECTION 2

INSTRUMENT POSITIONING & MEASUREMENT TECHNIQUES

General

The variety of items that the SP78 can measure is almost endless. However, in order to obtain accurate and repeatable measurements, the bottom of the shoe must be:

* *Parallel* with the surface to be measured if the surface is *flat*.

* *Tangent* to the surface to be measured if the surface is *curved.*

The reason for this is that any movement during measurement can cause the reading to vary. To obtain the most accurate and repeatable measurements, there are a few guidelines you can follow.

If the item to be measured is smaller than the shoe, you may want to make a platform (the same height of the item) for the instrument to sit on. If the item to measure is curved, you may want to make a jig for the item to rest in.

Specular Excluded Mode

Measurements taken in the specular component excluded mode are inherently geometry sensitive. The specular excluded mode will detect slight differences in surface texture. If specular excluded is used, the averaging mode should also be used (e.g.; average 3-5 readings per measurement).

☞ The inherent sensitivity to surface geometry (i.e.; pits, scratches, textures, etc.) is greatly enhanced in the small area view model (SP78S), and will result in increased measurement variability. For this reason, use of the specular excluded mode is not recommended for this model.

Dark Colors

For best accuracy and repeatability when measuring dark or high chroma colors, the instrument should be calibrated more frequently. Also, the "auto averaging" mode should be used when measuring dark and high chroma colors. When set to auto averaging, the instrument will automatically require three measurements if an X, Y, or Z value of 2.5% or less is detected. Refer to Section 7.2 for averaging setup.

Non-Uniform Samples

Non-uniform samples such as plaids and patterned materials should also be measured using the averaging mode (3-5 readings), for both the specular included and excluded modes.

Positioning Example

Shown below is one method that can be used to position the instrument when measuring a paint chip.

Measuring a Paint Chip

CORRECT

Paint Chip   **Platform**

INCORRECT
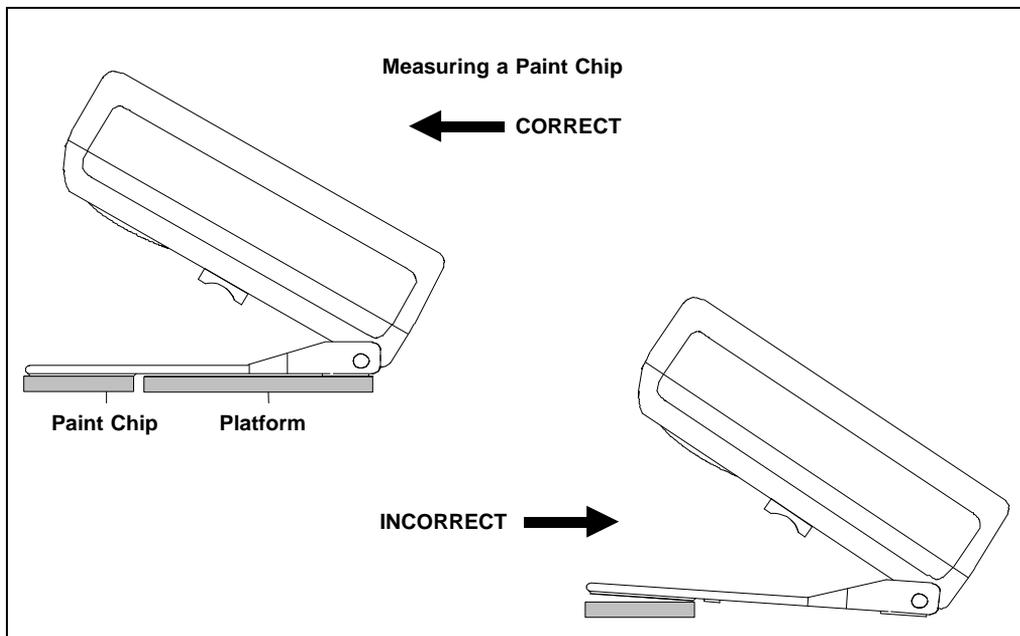
SECTION 3

NORMAL OPERATION

Subjects covered in Section 3 are:

* 3.1 Menu Page Selection and Display Description
* 3.2 Color Space Selection
* 3.3 Illuminant/Observer Selection
* 3.4 Reference Measurement
* 3.5 Taking a Sample Difference Measurement
* 3.6 Taking a Sample Absolute Measurement
* 3.7 Using Averaging

3.1 MENU PAGE SELECTION AND DISPLAY DESCRIPTION

The main menu is contained in two pages. To advance through the page menus, continually press Key #1.

norm (normal) - this key will always return the display to the main screen (L*a*b*, L*C*h°, etc.). The normal key is used to exit storage and qc functions.

qc (quality control) - the qc function will allow up to 50 preset "setups." Each "setup" consists of a tolerance method, tolerancing limits, reference measurement, and 555 shade tag options for pass/fail operation.

```
L*    95.66      INCLUDED
C*     8.64
h°  273.79
menu  L*C*h°   D65^10  dif
```

Key#1 Key#2 Key#3 Key#4

```
MENU PAGE 1

pg2    norm    qc    store
```

Key#1 Key#2 Key#3 Key#4

```
MENU PAGE 2

exit    cal    cnfg
```

Key#1 Key#2 Key#3 Key#4
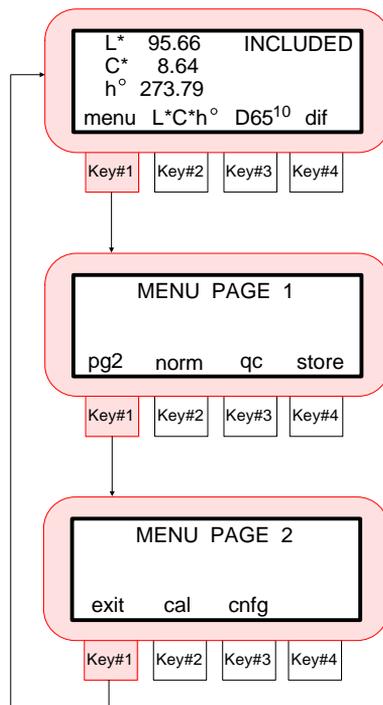
storage - storage mode allows measurement data to be stored, edited, and printed from selected groups. Store measurements can also include scanned tags with use of the optional bar code reader. This function can also be used with X-Rite's QA-Master software program.

cal (calibration) - the cal key accesses the calibration function where white calibration and zero reflectance measurements are performed.

cnfg (configuration) - operation options, printing formats, and communication parameters are set under this function.

The characters in the display above each key switch dictate which function will be selected or which action will take place when a key switch is pressed. Normally, uppercase lettering is used for display messages, and lower-case lettering is used for menu options that are selectable by the user.

Absolute Measurement Display
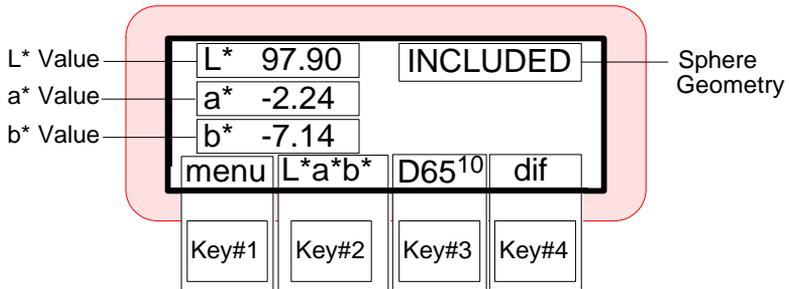
Difference Measurement Display
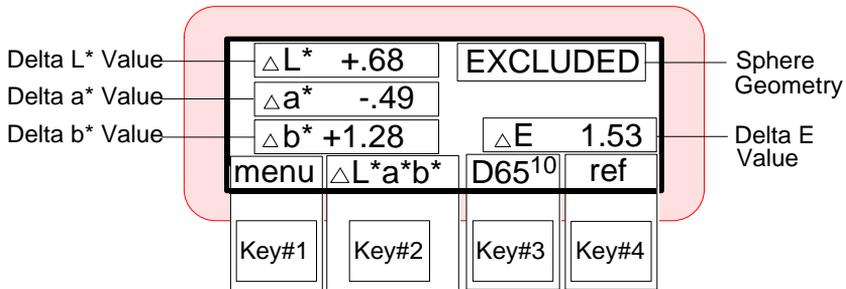
☞ Sphere geometry (specular included or specular excluded) is selected in the Operation Options setup. Refer to Section 7.2.

3.2 COLOR SPACE SELECTION

There are thirteen colorimetric systems (absolute and difference) that can be selected when displaying measurement data. Each momentary depression of "Key #2" will page through: L*a*b*, L*C*h°, XYZ, Lab (Hunter), Wht, Yel, Yxy and ΔE_{CMC}. Pressing the "dif" key will display the difference values for the selected color space.

☞ The instrument is shipped from the factory with XYZ, Hunter Lab, Wht, Yel and Yxy turned off. Refer to Operation Options in Section 7.2 to turn On and Off color space options.

Yellowness will only allow C^2 as an illuminant/observer.

To select a color space:

- Repeatedly press **"Key #2."**

- Press **[dif]** key #4 to select difference mode of color space.
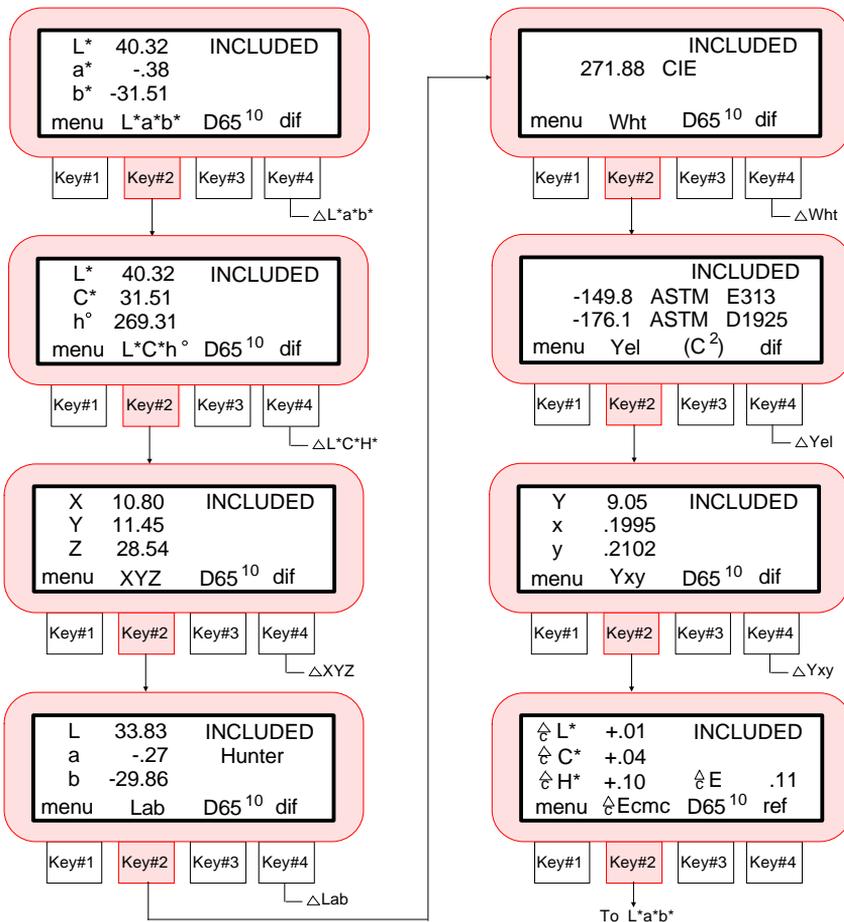
3.3 ILLUMINANT/OBSERVER SELECTION

The SP78 has eighteen illuminant/observer combinations that can be selected. Any illuminant/observer can be selected after a measurement to view the values under different conditions.

To select an illuminant/observer:

- Repeatedly press **"Key #3."**

```
L*   97.98      INCLUDED
 a*   -.77
 b*  -7.24
menu L*a*b*   C 2    dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
 L*   98.34      INCLUDED
  a*   -2.83
  b*   -6.42
menu L*a*b*   C 10    dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

$D65^2$ **(Daylight 6500k)**
$D65^{10}$

$D50^2$ **(Daylight 5000k)**
$D50^{10}$

A^2 **(Incandescent)**
A^{10}

$F2^2$ **(Cool White)**
$F2^{10}$

$F7^2$ **(Broad Band)**
$F7^{10}$

$F11^2$ **(TL84)**
$F11^{10}$

$F12^2$ **(Ultralume)**
$F12^{10}$

$D75^2$ **(Daylight 7500k)**
$D75^{10}$
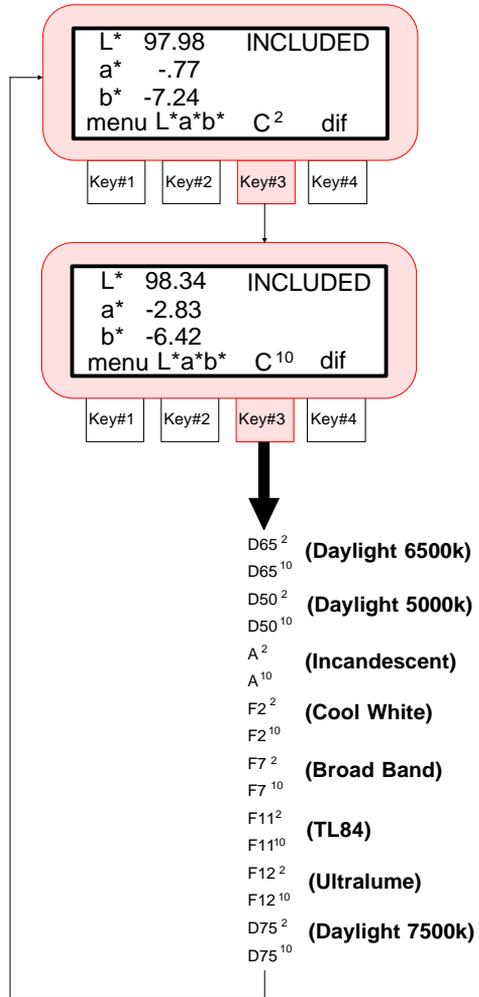
☞ All illuminant/observer combinations may not display. Certain combinations may be turned off in Operation Options (Section 7.2). $D65^{10}$, A^{10}, and $F2^{10}$ are preset on at the factory.

3.4 REFERENCE ENTRY

The SP78 can display the difference between a reference and a sample. In order to display these differences, the reference must first be entered. The reference can either be measured or manually entered. When the **"AUTO SETUP"** option in Sec. 7.2 is set to "off", a reference can be manually entered. When **"AUTO SETUP"** is set to "on" with a selected illum/obs, a reference can be measured.

In normal operation, the SP78 stores a single reference against which all subsequent measurements are compared. In QC operation (see Section 4), a separate reference can be entered for each of the 50 setups.

The measured references are stored spectrally and the tristimulus values are recalculated each time a different illuminant/observer is selected. The tristimulus values are entered for manual references.

To enter reference in normal operation:

1) Select desired color space and illuminant/observer.

2) Press the **[dif]** key #4 to display difference color space.

3) Press the **[ref]** key #4.

4) Press the **[yes]** key #4 to enter reference menu.

   - **"MEASURE REFERENCE SAMPLE"** is displayed.

   - Continue with Step 5 to manually enter reference values. Advance to Step 6 to measure a reference.

$\Rightarrow$

5) **Manual Entered Reference**

☞ The **"+"**, **"-"**, and **"next"** key descriptions will not display if **"AUTO SETUP"** is **"on"** in modes (Sec. 7.2).

- Press **[next]** key #4 to move cursor to desired attribute.
- Press the **[+]** key #2 to increase the value.
- Press the **[-]** key #3 to decrease the value.
- After values are entered, advance to Step 7.

Cursor

```
L*     .00      REFERENCE
a*     .00
b*     .00      set02
exit    +        −      next
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Increase   Dcrease   Move Cursor
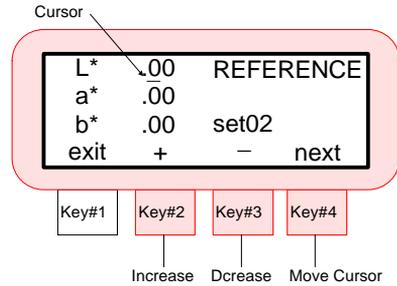
6) **Reference Measurement**

- Position the target window over reference to measure.

Reference

- Lower unit to target window and hold compressed.

- Release unit from reference after **"READING COMPLETE"** is displayed.
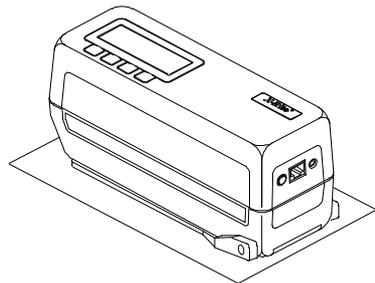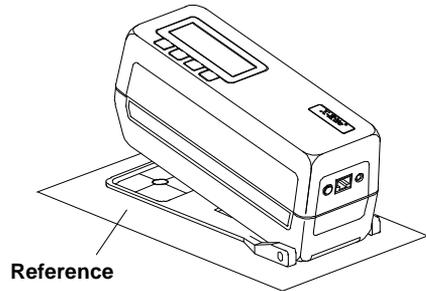
☞ If an error message occurs during the measurement, try reading reference again. If error message still occurs, refer to Display Messages in Appendix B.

7) The reference data is entered, and instrument is ready for a sample difference measurement.

- Press **[exit]** key #1 to return to normal operation.

```
L*    98.10     REFERENCE
a*    -2.91
b*    -9.08
exit    +        −      next
```

| Key#1 | Key#2 | Key#3 | Key#4 |
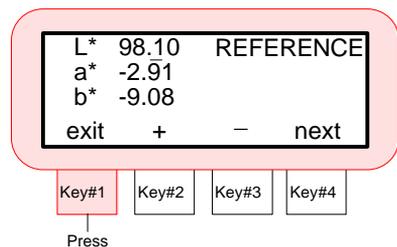
Press

3.5 TAKING A SAMPLE DIFFERENCE MEASUREMENT

The SP78 can display numeric difference data as: ΔL*a*b*, ΔL*C*H*, ΔE, ΔXYZ, ΔLab (Hunter), ΔWht, ΔYel, and ΔEcmc. Difference data can also be expressed as "words" (i.e., brighter, >>red, etc.). refer to Section 7.2 for Delta Expression selection.

To take a sample difference measurement:

1) Make sure a reference is entered into the instrument (see Reference Entry, Sec. 3.4).

2) Select color space by pressing **"Key #2."** Select desired illuminant/ observer by pressing **"Key #3."**

☛ Yellowness will only allow C^2 as an illuminant/observer.

```
L*    98.10         INCLUDED
a*    -2.91
b*    -9.08
menu   L*a*b*   D65¹⁰  dif
```

Key#1 | Key#2 | Key#3 | Key#4

Press   Press
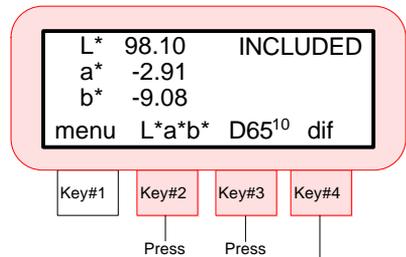
3) Press **[dif]** to select difference color space.

```
△L*    .00         INCLUDED
△a*    .00
△b*    .00              △E    .00
menu  △L*a*b*  D65¹⁰  ref
```

Key#1 | Key#2 | Key#3 | Key#4
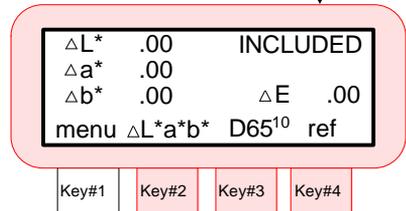
4) Center the target window over sample to be compared.
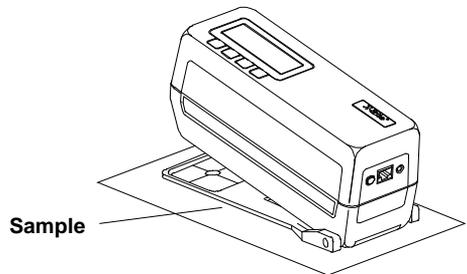
Sample

5) Lower unit firmly to target window
   and hold compressed.
   - Release unit from sample after
     "READING COMPLETE" is displayed.
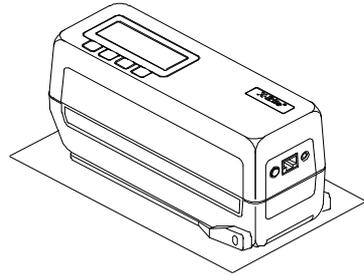
☞ If an error message occurs during the measurement,
   try reading sample again. If error message still
   occurs, refer to Display Messages in Appendix B.

6) The display will show the difference
   between the reference and the sample
   measured.

   - The sample difference can be viewed
     under different illuminant/observer
     conditions by pressing **"Key #3."** The
     absolute value or a different color space
     can also be viewed by pressing **"Key
     #2."**
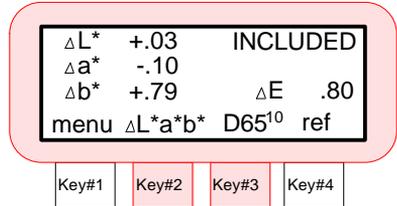
△L*	+.03	INCLUDED
△a*	-.10	
△b*	+.79	△E	.80
menu	△L*a*b*	D65^{10}	ref

Key#1 Key#2 Key#3 Key#4

Word Expression Notes:
- No words will display for an attribute that is less than "1/7" of the
  Delta E value. A value less then this amount is considered insignificant
  compared to the total difference.
- If the delta value for any attribute is greater than 10.00, the display will
  change to numeric values.

3.6 TAKING A SAMPLE ABSOLUTE MEASUREMENT

The instrument can display an absolute measurement as L*a*b*, L*C*h°, XYZ, Lab (Hunter), Wht, and Yel.

To take an absolute measurement:

1) Select absolute color space by pressing **"Key #2."** Select illuminant/observer by pressing **"Key #3."**

☞ Yellowness will only allow C^2 as an illuminant/observer.

```
L*    98.13      INCLUDED
a*    -3.01
b*    -8.29
menu  L*a*b*  D65¹⁰  dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press Press
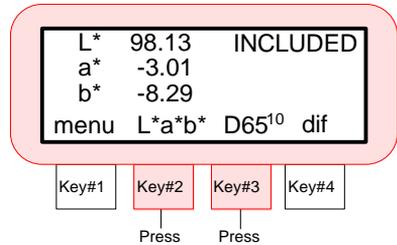
2) Position the target window over sample to be measured.
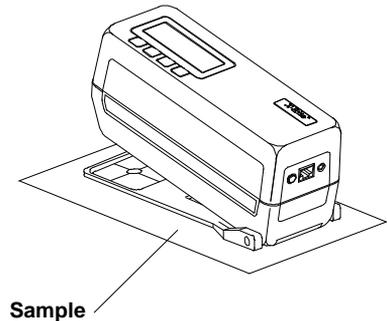
Sample

3) Lower unit firmly to target window and hold compressed.

- Release unit from sample after **"READING COMPLETE"** is displayed.
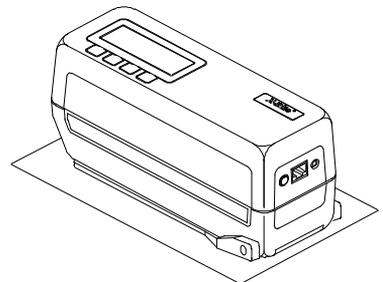
☞ If an error message occurs during the measurement, try reading sample again. If error message still occurs, refer to Display Messages in Appendix B.

4) The display will show the absolute values of the sample for the selected color space.

   - The sample can be viewed under different illuminant/observer conditions by pressing **"Key #3."** A different color space can also be viewed by pressing **"Key #2."**

```
 ┌─────────────────────────────┐
 │  L*    95.66      INCLUDED   │
 │  a*    +.57                  │
 │  b*    -8.62                 │
 │ menu  L*a*b*  D65¹⁰   dif    │
 └─────────────────────────────┘
  Key#1   Key#2   Key#3   Key#4
```
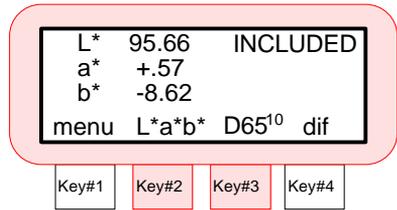
3.7 USING AVERAGING

Measurement averaging allows several (1 - 16) measurements to be taken at different locations on a single sample or reference, to obtain a better overall value. Averaging should be used when measuring non-uniform samples, textured materials, and any dark or high chroma color, especially when specular excluded mode is used. When set to auto averaging, the instrument will automatically require three measurements if an X, Y, or Z value of 2.5% or less is detected.

Averaging must first be activated in Operation Options (Section 7.2). When averaging is activated, the averaging sequence will occur on all reference and sample measurements.

The following example has an average measurement of "2" in L*C*h° absolute function.

To take an average measurement:

1) Select desired measurement function by pressing **"Key #2."** Select illuminant/observer by pressing **"Key #3."**
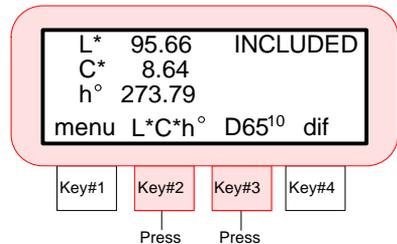
2) Center the target window over the first sample area to be measured.
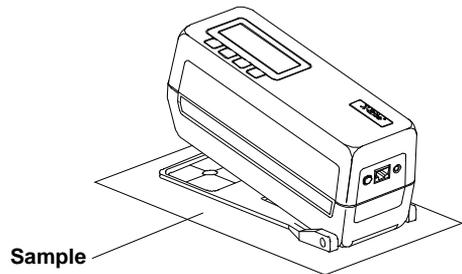
3) Take measurement by lowering unit to target window on sample.

   - Release unit off of first area on sample when **"READING COMPLETE"** is displayed.
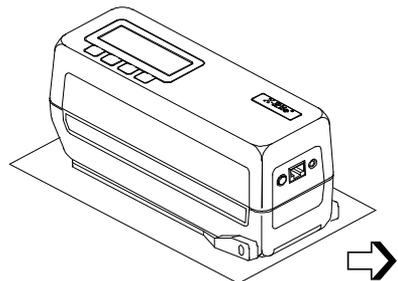
4) **"MEASURE SAMPLE 2 OF 2"** is
   displayed.

☞ Measurement averaging can be aborted at
   anytime by pressing **[reset]** key #1. The last
   measurement taken will be the data that is
   displayed.

```
MEASURE SAMPLE
    2 OF 2

reset
```
| Key#1 | Key#2 | Key#3 | Key#4 |
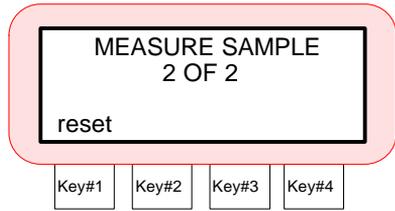
5) Center the target window over
   second area on sample.
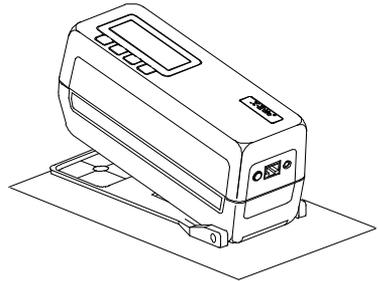
6) Take measurement.
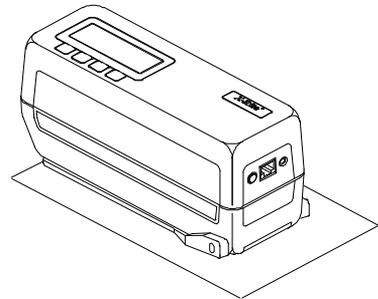
7) **"AVERAGE CALCULATED"** is
   displayed and then the averaged
   measurement data.

```
L*     66.92    INCLUDED
C*     49.33
h°   152.84
menu  L*C*h°  D65¹⁰  dif
```
| Key#1 | Key#2 | Key#3 | Key#4 |
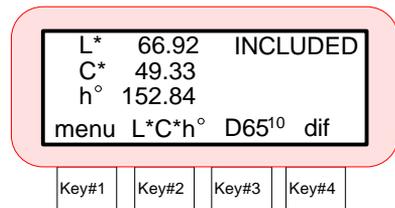
SECTION 4
QUALITY CONTROL (QC) OPERATION

Subjects covered in Section 4:

* 4.1 Defining Setups
* 4.2 QC Reference Entry
* 4.3 Pass/Fail and 555 Shade Tag Operation

Pass/Fail displays the difference (numerically or by words) between the reference and sample. After a measurement is taken, a pass or fail signal will then be indicated dependent on the tolerances assigned in the QC Setups.

Once all required "setups" are established, Auto Setup option can be used to automatically select the closest setup to the sample being measured. The closest match is selected based on a the setup reference values and the illum/obs selected in the Auto Setup option (Sec. 7.2). Once the SP78 selects the closest setup, the data displayed will be based on that individual setup options (i.e.; pass/fail tolerance, illum/obs, etc). This auto measurement technique provides a fast and reliable method of measuring samples with very little key operation.

555 Shade Tagging allows a means of expressing usable information on different variations of shaded samples. These samples are sorted and placed into selected shade groups. This allows the same color fabric, ceramics, etc. from different manufacture runs to be sorted in shade groups, and used together in final use. 555 Shade Tagging & Pass/Fail function will display a shade tag number and indicate pass/fail status based on set tolerances.

When QC operation is used in storage mode, individual measurements can be tagged using the optional bar code reader. This measurement data with scanned tags can then be uploaded to X-Rite's QA-Master software package.

The "Delta Expression" option in System Configuration (Sec. 7.2) gives you the ability to display measurement differences numerically or by words–which indicate color direction or intensity. For example, the color direction and intensity may indicate that a sample is "lighter", ">>red" (more red), etc. than the reference.

4.1 Defining Setups

☞ Setups must be defined in QA-Master if stored sample data is to be uploaded to QA-Master. Refer to Section 21 in QA-Master Reference Manual for procedure.

The SP78 will store up to 50 individual "setups" with user defined options. This provides a very versatile instrument that can measure a broad range of samples with varying characteristics (i.e., surfaces, textures, etc.), and indicate a pass/fail and 555 sort tag. A "setup" is defined by three options: Measurement Specifications (meas), Shade Sort Options, and Pass/Fail Options (p/f). The measurement specifications should be defined first in order for the proper color space option to be displayed in shade sort and pass/fail option menus.

To enter QC setup procedure:

1) In normal mode, press **[menu]** key #1 until **"MENU PAGE 1"** is displayed.
 - Press **[qc]** key #3.

```
        MENU  PAGE  1


  pg2    norm    qc    store
```

| Key#1 | Key#2 | Key#3 | Key#4 |

2) Press **[set#]** key #3.

```
△L*    .00         555
△a*    .00
△b*    .00      △E      .00
menu   func   set01   ref
```

| Key#1 | Key#2 | Key#3 | Key#4 |

3) Press the [↓] key #2 to decrement through the "setups" or [↑] key #3 to increment through "setups." The number of "setups" displayed depends on the amount defined in Operation Options (Sec. 7.2). The default setting is 50.
 - Once the desired "setup" is selected, press **[define]** key #4.

```
        SETUP  =  01

  load    ↓ select ↑   define
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Decrement   Increment

Continued

☞ The **[load]** key is used to select a "setup" for operation once it has been defined. Load will be covered in Section 4.3.
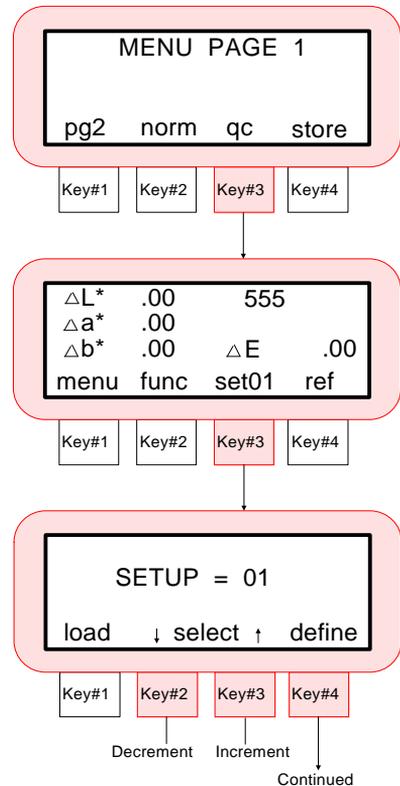
- The "setup" options shown, pass/fail (p/f), shade sort, and measurement specifications will be covered in the following three procedures. Measurement specs should be defined first so that the selected color space will appear in the other options.

```
        ┌──────────────────────────┐
        │   DEFINE  SETUP  #01      │
        │                          │
        │              shade       │
        │  exit    p/f  sort  meas  │
        └──────────────────────────┘
     ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
     │Key#1 │ │Key#2 │ │Key#3 │ │Key#4 │
     └──────┘ └──────┘ └──────┘ └──────┘

        Pass/Fail Options
             Shade Sort Options
                  Measurement Specifications
```
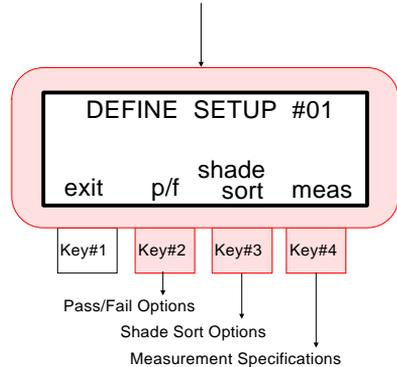
4) When all setup options are defined, press the **[exit]** key #1 to save setup and return to **"SETUP"** menu. At this point additional setups can be defined or the one that was defined can be loaded, and a reference measurement can be performed (see Sec. 4.2).

Measurement Specifications (meas)

The measurement specifications screen is used to define the color space, illum/obs, and measurement averaging. Refer below and to the next pages for a definition of each option followed by the selection procedure.

Color Space - Is used to select the color space the setup will use for calculating color differences used in pass/fail and shade sorting. The available options are: $\Delta L*a*b*$, $\Delta L*C*H*$, ΔXYZ, ΔLab (Hunter), ΔWht, ΔYel, and $\Delta Ecmc$.

☞ All color space selections may not display. Certain color spaces may be turned off in Operation Options (Section 7.2).

L*a*b* - is based on the opponent-colors theory of color vision that states: a color cannot be both green and red at the same time, or blue and yellow at the same time. As a result, single values can be used to describe the red/green and the yellow/blue attributes. When a color is displayed in Lab, "L*" defines lightness, "a*" denotes the red/green value, and "b*" the yellow/blue value. The "*" denotes calculation per the CIE Colorimetry Publication 15.2.

L*C*h° - color space is calculated from L*a*b*. The "L*" defines lightness, "C*" specifies chroma, and "h°" denotes hue angle. L*C*h° sometimes offers an advantage over L*a*b* in that it's easy to relate to the earlier system that is based on physical samples, like the Munsell color space.

XYZ - X, Y and Z are the CIE tristimulus values calculated per ASTM E308-90. X,Y and Z are used in calculating the other color spaces and indices. If the tristimulus values are equal for a given pair of samples, under a specified observer, illuminant, and geometry of illumination and view, the samples will visually match under these conditions.

Lab (Hunter) - is an opponent-colors based system similar to L*a*b*, developed in 1942 by the late Richard Hunter.

Wht - whiteness index is used as a preference rating for how white a material should appear. Whiteness is calculated per ASTM E313 (We) and per CIE 15.2 (W).

Yel - the ASTM's E313 yellowness index (Ye) is used to determine the amount to which a sample color can shift away from an ideal white. The D1925 yellowness index (Yd) is used for measuring plastics.

CMC - is an acronym for the **Colour Measurement Committee of the Society of Dyers and Colourists.** CMC equations are mathematical modifications to the formula used to calculate small color differences or color error (DE) in CIE L*C*h° color space. The purpose of the CMC equations is to appropriately distort the scaling of the L*C*H* (Lightness, Chroma, & Hue) components for the DE (color error) calculation. This provides a much better agreement between human visual assessment and instrumental measurement of small color differences.

A single CMC DE tolerance value describes, in L*C*h° color space, an ellipsoid around the standard color where the semi-axes correspond to the Lightness, Chroma, and Hue of the standard. This ellipsoid represents the "volume of acceptability" for that given color standard with a DE_{CMC} less than or equal to the given tolerance. For any given tolerance, the ellipsoid will vary in both size and shape depending on the position of the standard in L*C*h° color space.

It is this automatic adjustment to the "volume of acceptability", compensating throughout the color space making CMC tolerancing so desirable, for matching human sensitivity to color difference. The CMC equation is summarized as follows:

The volume of acceptance is defined by $DE_{CMC} \leq cf$ where:

$$DE_{CMC} = \left[\left(\frac{\Delta L}{S_L \iota} \right)^2 + \left(\frac{\Delta C}{cS_c} \right)^2 + \left(\frac{\Delta H}{S_H} \right)^2 \right]^{.5}$$

Where S_L, S_c, S_H are the semi-axes lengths for a 1.0 DE_{CMC} ellipsoid. (If complete equations for generating DE_{CMC} are desired, see AATCC TEST Method 173-1989.)

The CMC adjustment menu consists of the three parameters that can be set: Commercial factor *(cf)*, Lightness factor *(ι)*, and Chromaticity factor *(c)*.

* The commercial factor is the tolerance limit that each sample is not to exceed. (e.g., if cf= 1.00 then any sample which has a ΔE value greater than 1.00 would be commercially unacceptable.) The *"cf "* will have to be adjusted to meet the requirements of each measuring situation. For example, the color match of formal clothing may require a *"cf "* of .50 or less. However, a *"cf "* of 2.00 or more may be an adequate color match when measuring blue denim. A starting point value of .90 for *"cf "* is recommended.

* The lightness factor is normally set to 2.00 (default) but other values may be required when surface characteristics differ dramatically. This value of *" ι "* should be assumed best for textile measurement until actual results indicate a need for adjustment. Increasing *" ι "* or *"c"* will increase the tolerance to variations of the lightness or chroma components of the color error respectively.

For the textile industry it is unlikely that the chromaticity factor normally will require any adjustment from the default setting of 1.00.

Illuminant/Observer - Is used to select the illum/obs combination that the setup will measure samples under. The available combinations are: C^2, C^{10}, $D65^2$, $D65^{10}$, $D50^2$, $D50^{10}$, A^2, A^{10}, $F2^2$, $F2^{10}$, $F7^2$, $F7^{10}$, $F11^2$, $F11^{10}$, $F12^2$, $F12^{10}$, $D75^2$, and $D75^{10}$.

☛ All illum/obs combinations may not appear. Certain combinations may be turned off in Operation Options (Sec. 7.2).

Averaging - Allows you to enter the number of measurements (1-5) that must be taken with the instrument on the same sample, to obtain an average value. The Auto Averaging (A) setting will automatically require three measurements if an X, Y, or Z value of 2.5% or less is detected.

☛ If "Auto Setup" is turned "on" in Operation Options (Sec. 7.2), individual "setup" averages will not be allowed. The Setup will use the global averaging number (if any) that is selected for the "Averaging" parameter in Operation Options (Sec. 7.2).

To set measurement specification options:

1) Press the **[meas]** key #4 at **"DEFINE SETUP #"** menu level.

2) Press the **[color space]** key #2 to select color space required.

3) Press the **[illum/obs]** key #3 to select desired illum/obs combination.

4) Press the **[avg #]** key #4 to select **1, 2, 3, 4, 5,** or **A** (auto) averaging method.

5) When all options are selected, press the **[exit]** key #1 to return to **"DEFINE SETUP #"** menu.

```
        DEFINE  SETUP  #01

                      shade
       exit     p/f   sort    meas
```
Key#1   Key#2   Key#3   Key#4

```
       MEASUREMENT
       SPECIFICATIONS =

       exit △L*a*b*  D65^10  avg=1
```
Key#1   Key#2   Key#3   Key#4

△L*C*H*   C ^{2} 1
△XYZ
△Lab (Hunter)   D75 ^{10} 5
△Wht   A (auto)
△Yel
△Ecmc
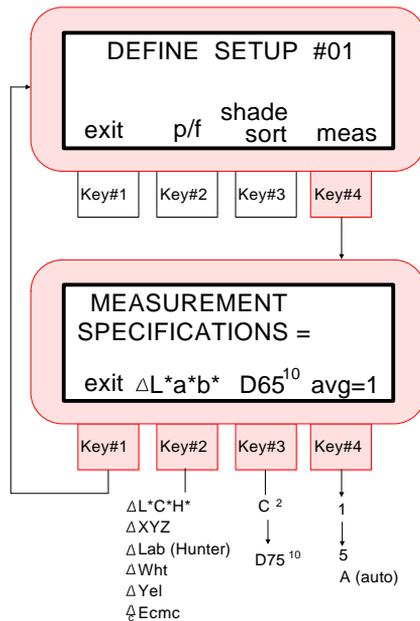
Shade Sort Options

The shade sort option is used to define the shade sort size and shade sort range for the 555 tagging method. Refer below and to the next page for a description of each option followed by the selection procedure.

Shade Sort Size - The shade sort size are dimensions placed on the color space attributes. The value represents a three dimensional box in space. These boxes are layered nine deep on each axis and at the center is the 555 reference box. This box represents your reference color. The value in the L*, a*, and b* fields determine the reference box size. Enter a smaller value for a tighter tolerance. Values range from .01 to 9.99.

Shade Sort Range - Determines the range of 555 shade tag boxes to be used and displayed. The range can be set from 1 to 9 in the three dimensional space.
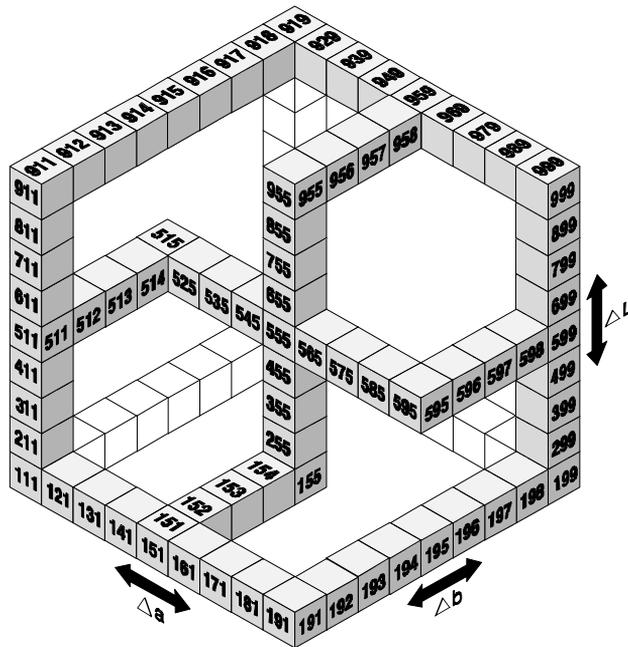
The 555 Shade Sort Solid System

To set shade sort options:

1) Press the **[shade sort]** key #3 at **"DEFINE SETUP"** menu level.

DEFINE SETUP #01

exit   p/f   shade   meas
                  sort

Key#1   Key#2   Key#3   Key#4

— Cursor

2) Set the shade sort size (.01 - 9.99).
 - Press the **[next]** key #4 to move cursor to desired attribute.
 - Press the **[+]** key #2 to increase attribute value.
 - Press the **[-]** key #3 to decrease attribute value.

SHADE SORT SIZE =
L*   a*   b*
.10   .10   .10
exit   +   −   next

Key#1   Key#2   Key#3   Key#4

          Increase Decrease Move
                           Cursor

3) When values are set for each attribute, press the **[exit]** key #1 to advance to the **"SHADE SORT RANGE"** menu.

4) Set the shade sort range (1-9).
 - Press the **[next]** key #4 to move cursor to desired attribute.
 - Press the **[+]** key #2 to increase attribute value.
 - Press the **[-]** key #3 to decrease attribute value.

SHADE SORT RANGE =
L*   a*   b*
1 to 9   1 to 9   1 to 9
exit   +   −   next

Key#1   Key#2   Key#3   Key#4

          Increase Decrease Move
                           Cursor

5) When all values are selected, press the **[exit]** key #1 to return to **"DEFINE SETUP #"** menu.
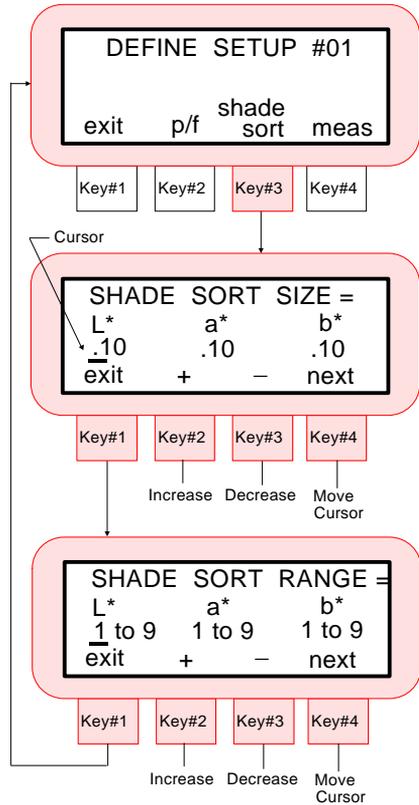
Pass/Fail Options

The pass/fail option is used to define the tolerancing method and limits. Refer below and to the next page for a description of each option followed by the selection procedure.

Tolerancing Method - A "delta E only" or "all attribute" tolerance method can be selected for ΔL*a*b*and ΔL*C*H* color space. If ΔXYZ, ΔLab (Hunter), ΔWht, or ΔYel was selected as the color space method in measurement specifications menu, the pass/fail tolerancing method option would not display.

Pass/Fail Limits - Are individual limits set on each attribute of the selected color space. In cases where the DE tolerance method is selected, only one value is entered.

To set pass/fail options:

1) Press the **[p/f]** key #2 at the **"DEFINE SETUP #"** menu level.

DEFINE SETUP #01

exit   p/f   shade
                 sort   meas

Key#1   Key#2   Key#3   Key#4

2) Set the pass/fail method. This menu will only appear if ΔL*a*b* or ΔL*C*H* was selected in measurement specifications.
 - Press the **[method]** key #2 to select pass/fail method.

△Ecmc
△XYZ
△Lab (Hunter)
△Wht
△Yel

PASS/FAIL METHOD =

exit   △L*a*b*

Key#1   Key#2   Key#3   Key#4

3) When method is selected, press the **[exit]** key #1 to advance to **"PASS/FAIL LIMITS"** menu.

DL*a*b*, DL*C*H*, or DE

Continued
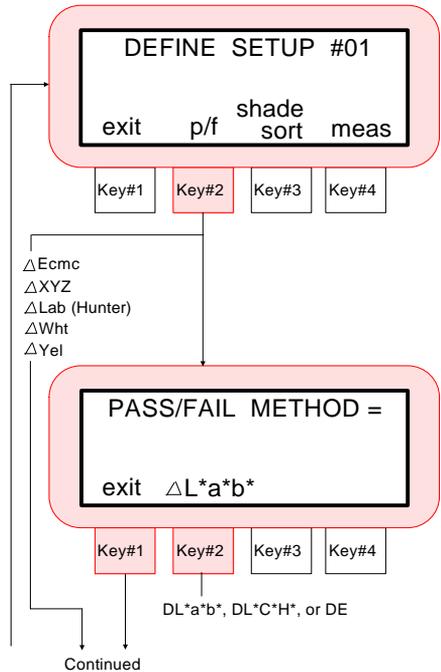
4) Set the pass/fail limits.
   - Press the **[next]** key #4 (if
     applicable) to move cursor to
     desired attribute.
   - Press the **[+]** key #2 to increase
     attribute value.
   - Press the **[-]** key #3 to decrease
     attribute value.

```
   PASS/FAIL  LIMITS =
   L*          a*          b*
   1.00       1.00        1.00
   exit        +           −      next
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Increase Decrease Move
                    Cursor
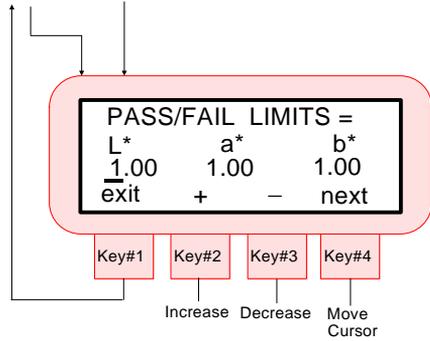
5) When all values are selected, press
   the **[exit]** key #1 to return to
   "DEFINE SETUP #" menu.

6) Refer to Section 4.2 for procedure
   on "loading" a setup and measuring
   a reference.

4.2 QC Reference Entry

The SP78 will store a separate reference for each of the setups. The reference will remain with the selected setup until changed. The reference can either be measured or manually entered. When the **"AUTO SETUP"** option in Sec. 7.2 is set to "off", references can be manually entered. When **"AUTO SETUP"** is set to "on" with a selected illum/obs, references can be measured.

To take a reference measurement:

1) At the QC menu level, press the **[set#]** key #3 if desired setup number is not displayed.

2) Select the desired setup # by pressing the [↑] key #3 to increment or [↓] key #2 to decrement through setups.
- Press the **[load]** key #1 to select displayed setup number.

3) Press the **[ref]** key #4.

4) Press the **[yes]** key #4 to enter reference menu.

- **"MEASURE REFERENCE SAMPLE"** is displayed.

- Continue with Step 5 to manually enter reference values. Advance to Step 6 to measure a reference.
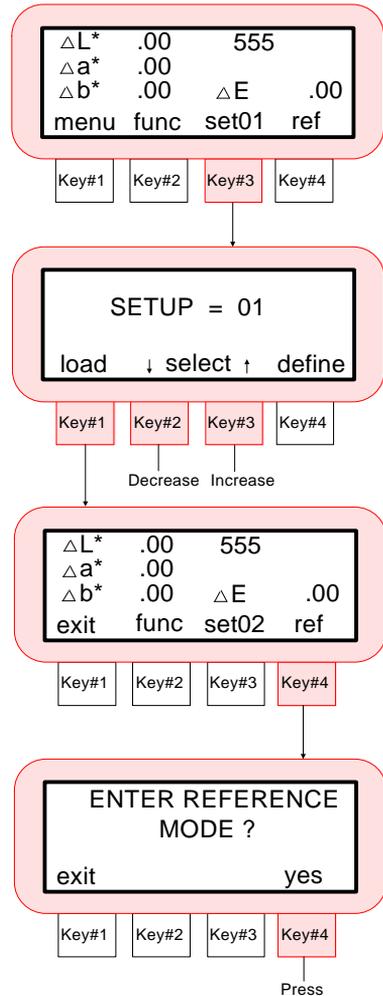
5) **Manual Entered Reference**

☞ The "+", "-", and "next" key descriptions will not display if "AUTO SETUP" is "on" in modes (see Sec. 7.2).

Cursor

```
L*   .00    REFERENCE
a*   .00
b*   .00    set02
exit  +     −     next
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Increase   Dcrease   Move Cursor

- Press **[next]** key #4 to move cursor to desired attribute.
- Press the **[+]** key #2 to increase the value.
- Press the **[-]** key #3 to decrease the value.
- After values are entered, advance to Step 7.
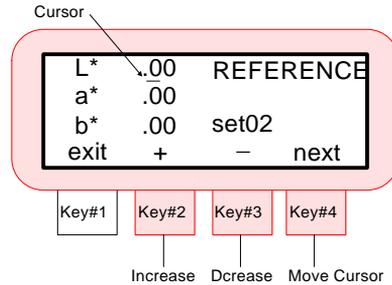
6) **Reference Measurement**

- Position instrument on reference to measure.

Reference

- Lower unit to target window and hold compressed.

- Release unit from reference after **"READING COMPLETE"** is displayed.
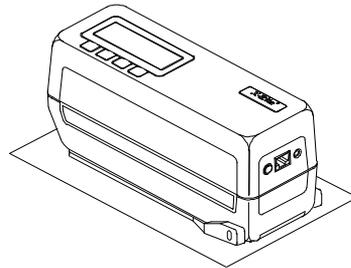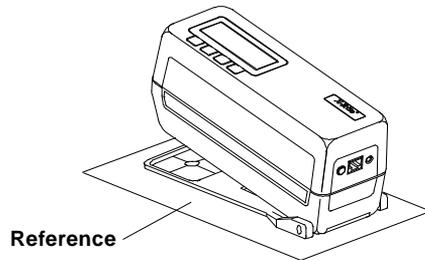
☞ If an error message occurs during the measurement, try reading reference sample again. If error message still occurs, refer to Display Message in Appendix B.

7) The measurement reference data will remain in the selected setup until changed.

```
L*  95.30   REFERENCE
a*  -1.28
b*  +.66    set02
exit   +    −     next
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press

- Press the **[exit]** key #1 to return to QC menu level.
- Refer to Section 4.3 for QC measurement procedures.
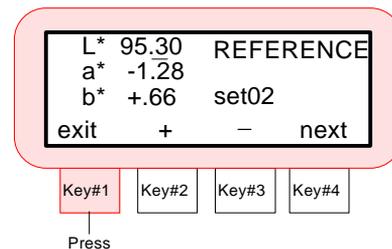
4.3 Pass/Fail and 555 Shade Tag Operation

The SP78 will display three QC measurement functions: pass/fail, 555 shade tag, and pass/fail & 555 shade tag. Once a measurement is taken, it can be viewed under any of the three measurement functions.

There are two methods that can be used to express the measured differences. The first method is by showing the differences numerically. The second method is by expressing the difference using words (see below). XYZ, Wht, and Yel will not display differences in words. Difference expression as numbers or words is selected in the System Configuration, Section 7.2.

When delta words are used, the "L*" attribute for L*a*b* or L*C*H* will display either **"LIGHTER"** or **"DARKER"** from the reference. The "a*" and "b* " attributes for L*a*b* and the "H*" (hue) attribute for L*C*H* will display as **">>RED"**, **">>GRN"**, **>>BLU",** or **">>YEL."** This is an indication of what color direction the attribute is towards. For L*C*H*, the "C*" (chroma) attribute will display as **"BRIGHTER"** or **"DULLER."**

☞ No words will display for an attribute that is less than "1/7th" of the Delta E value. A value less than this amount is considered insignificant compared to the total difference.
If the delta value for any attribute is greater than 10.00, the display will change to numeric values.

Pass/Fail Only Function

The pass/fail function will display the difference between the reference & sample, and indicate a pass or fail.

Pass/Fail Display Examples

△L*C*H* Delta Numbers

```
△L*   +.01      PASS ——
△C*   +.01
△H*   +.02   △E     .02
menu  func  set01   ref
```
— Acceptance Indication

△L*C*H* Delta Words

```
△L*   lighter    PASS
△C*   brighter
△H*   >>blu   △E     .02
menu  func  set01   ref
```

555 Shade Tag Only Function

The 555 shade tag function will display a 3 digit number (with 555 being the reference) based on the selected shade size and shade range parameters set.

555 Shade Tag Display Examples

△L*C*H* Delta Numbers

```
△L*     -.33    254  ────── Shade Tag
△C*     +.02
△H*     -.08   △E      .34
menu   func   set01   ref
```

△L*C*H* Delta Words

```
△L*    lighter    254
△C*    duller
△H*    >>blu    △E      .34
menu   func   set01   ref
```

If an up arrow "↑" or down "↓" arrow appears in the place of a shade tag number, this indicates that the tag number is out of tag range.

Pass/Fail & 555 Shade Tag Function

The pass/fail & 555 will display a shade tag number and pass or fail indication, based on the tolerance set.

Pass/Fail & 555 Shade Tag Display Examples

△L*C*H* Delta Numbers

```
△L*    -2.56    FAIL ────── Acceptance
△C*    +.14     ↓68  ────── Indication
△H*    +.29    △E    2.58   Shade Tag
menu   func   set01   ref
```

△L*C*H* Delta Words

```
△L*    lighter    FAIL
△C*    brighter   ↓68
△H*    >>blu    △E    2.58
menu   func   set01   ref
```

To take a QC measurement:

☞   Defining Setups (Sec. 4.1) and QC Reference Measurement (Sec. 4.2) must be performed before continuing with this procedure.

The following procedure will guide you through all the steps required to take a setup measurement. Measurement tagging using the optional bar code reader will be covered in Tagging and Storing, Section 5.2.

1) At **"MENU PAGE 1"** level, press **[qc]** key #3.

```
        MENU  PAGE  1


pg2    norm    qc    store
```

Key#1   Key#2   Key#3   Key#4
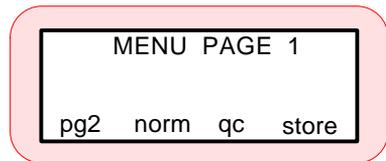
└── Sec. 5

Continued

☞ Advance to Step 5 if **"AUTO SETUP"** option
(see Sec. 7.2) is used.

2) At the QC menu level, press the
[set#] key #3 if desired setup # is
not displayed. If desired setup # is
displayed, advance to Step 5.

```
△L*    +.14      PASS
△a*     .00
△b*    +.04    △E      .15
menu   func   set01   ref
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Sec. 4.2

3) Select setup # by pressing the [↑]
key #3 to increment or [↓] key #2
to decrement through setups.
- Press the **[load]** key #1 to select
displayed setup #.

```
SETUP  =  01

load    ↓ select ↑    define
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Decrement   Increment

Sec. 4.1

4) Press the **[func]** key #2 to enter
function selection menu.

```
△L*    -.02      PASS
△C*   +.02
△H*    -.05    △E      .06
menu   func   set02   ref
```

| Key#1 | Key#2 | Key#3 | Key#4 |

5) Press the [↑] key #3 or [↓] key #2
to increment or decrement through
"PASS/FAIL", **"555 SHADE TAG"**,
and "PASS/FAIL & 555" functions.
- Press the **[exit]** key #1 after
function is selected.

```
FUNCTION  =
PASS / FAIL

exit      ↓ select ↑
```

| Key#1 | Key#2 | Key#3 | Key#4 |

555 Shade Tag
Pass/Fail & 555
Pass/Fail

☞ Display function can be changed after a
measurement is taken to view data in a
different function.

Continued

Pass/Fail and 555 Shade Tag
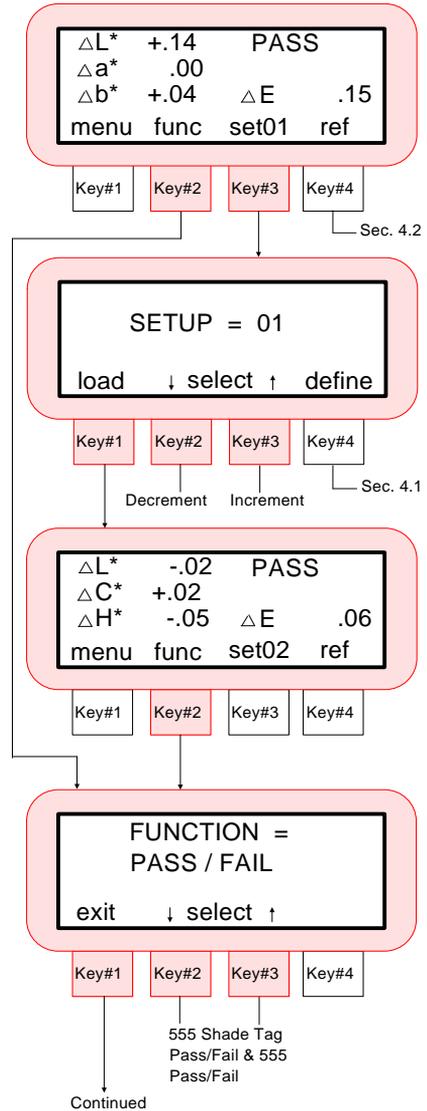
- The display will show the selected
  function.

```
△L*      -.02     PASS
△C*      +.02      554
△H*      -.05     △E      .06
menu    func    set02    ref
```

Key#1   Key#2   Key#3   Key#4

6) Position instrument on sample to
   measure.
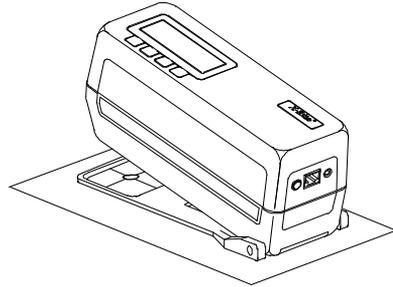
7) Lower unit to target window and
   hold compressed.
   - Release unit from sample after
     "READING COMPLETE" is
     displayed.

☞ If an error message occurs during the
    measurement, try reading sample again. If error
    message still occurs, refer to Display Message
    in Appendix B.
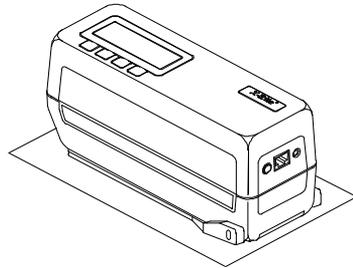
*Passed sample using delta
numbers and pass/fail & 555
function.*
- **PASS** will display to indicate
  passed sample.
- For shade tag "354", "3"
  represents the "L" attribute, "5"
  represents the "a" attribute, and
  "4" represents the "b" attribute.

```
△L*      -.13     PASS
△C*      +.03      354
△H*      -.11     △E      .17
menu    func    set02    ref
```

*Failed sample using delta
numbers and pass/fail & 555
function.*
- One long beep will be heard to
  indicate failed sample.
- When a tag number (L*, a*, or
  b*) is out of tag range (depending
  on settings), an arrow will indicate
  the direction. The "up" arrow
  indicates over and the "down"
  arrow indicates below.

```
△L*   -1.18      FAIL
△C*   +.34      ↓ 8 ↓
△H*    -.71     △E     1.42
menu  func   set02   ref
```

*Passed sample using delta words
and pass/fail & 555 function.*
- **PASS** will display to indicate
  passed sample.
- "Delta Words" is selected in the
  System Configuration, see Sec.
  7.2. "Delta Numbers" is the
  factory default setting. The sample
  passed, but is slightly **"lighter"**,
  "brighter", and towards **">>blu."**

```
△L*  lighter     PASS
△C*  brighter    655
△H*  >>blu    △E      .06
menu  func   set02   ref
```

*Failed sample using delta words
and pass/fail 555 function.*
- One long beep will be heard to
  indicate failed sample.
- The display indicates that the
  sample is **"lighter"**, **"brighter"**, and
  towards **">>blue."**

```
△L* lighter     FAIL
△C* brighter   ↓↑2
△H* >>blu    △E    3.31
menu   func   set02   ref
```

Subjects covered in Section 5 are:

* 5.1 Storing Measurements
* 5.2 Tagging and Storing (Optional)
* 5.3 Editing Stored Measurements
* 5.4 Printing Stored Measurements
* 5.5 Run Job Programmability

Storage operation allows measurement data to be stored, edited, and output to a printer. When the SP78 is used in conjunction with X-Rite's QA-Master software package, stored measurement data is "uploaded" directly into the application for visual analysis.

Stored sample measurements can also have scanned tags attached by use of the "optional" bar code reader. Group names can be assigned by scanning a tag. Individual measurements can have from 1 to 6 tags attached.

Data that is displayed during storage operation depends on what storage method is selected in Operation Options, Section 7.2. If "Store Data Only" is selected, the data displayed will be based on the last color space selected in normal operation. If "Store Data with QC" is set, the displayed data is based on the closest QC reference.

5.1 STORING MEASUREMENTS

Storage allows sample measurements to be assigned to group numbers. Once in storage mode, the operator can randomly selected group numbers and measure as many samples as desired in the select group. The instrument allows 999 samples to be stored in a maximum of 20 groups.

To store a measurement:

☛ Make sure that desired storage operation (Store Only or Store with QC) is selected in Operation Options, Sec. 7.2.

$\Rightarrow$

1) Press **[store]** key #4 at the **MENU PAGE 1** level to enter storage function.

```
          MENU PAGE 1


  pg2    norm    qc    store
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press

---
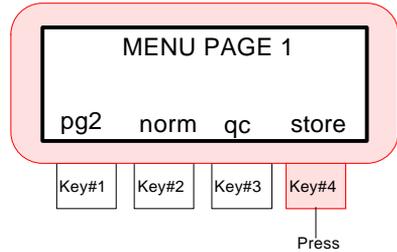
2) This step only needs to be performed if **"STORE DATA WITH QC"** is selected in Operation Options (Section 7.2). Advance to Step 3 if "auto setup" is activated.

Select the "setup #" that will be used in sample storage mode.

- Press **[edit]** key #4 to enter **"SELECT EDIT OPTION"** menu.

```
         DATA GROUP 1
  STORED:    0
  STORES REMAINING: 999
  menu  view   next   edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
      SELECT  EDIT OPTION


  exit   set01   del    print
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Sec. 5.3   Sec. 5.4
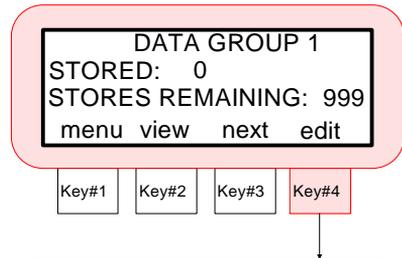
- Press **[set #]** key #2.

- Press [↓] key #2 to decrement and [↑] key #3 to increment through setup #'s.

- Press **[load]** key #1.

```
         SETUP = 01

  load   ↓ select ↑   define
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press

⇨
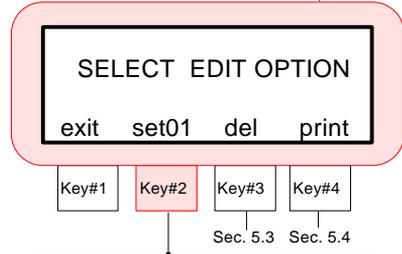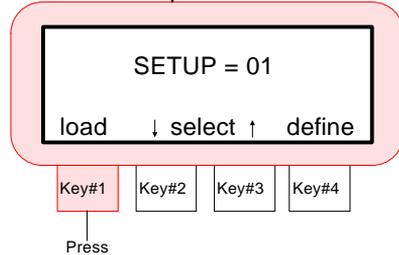
3) Select desired data group number by repeatedly pressing **[next]** key #3.

```
        DATA GROUP 1
STORED:    0
STORES REMAINING: 999
   menu  view  next  edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press

---
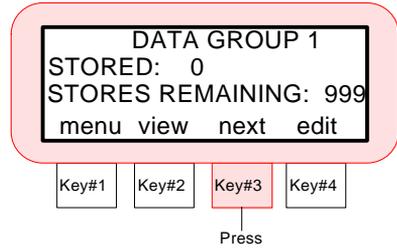
4) Take measurement by lowering unit to target window on sample and holding.
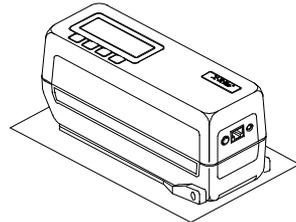
  - **"READING COMPLETE"**, **"Measurement Data"** and **"Pass/Fail"** indication is displayed with instrument held down.

☞ "Pass/Fail" indication will only display if "Storage with QC" is activated (see Section 7.2).

  - Release instrument from sample.

DATA DISPLAYED WITH UNIT HELD DOWN

OR **STORAGE WITH QC**

```
△L*    +.09     INCLUDED
△C*    -.02
△H*    -.06    △E     .11
  exit    (△L*C*H*)(D65¹⁰ )
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
△L*    -.06     PASS
△C*    -.03     455
△H*    -.04    △E     .11
  exit    (set02)
```

| Key#1 | Key#2 | Key#3 | Key#4 |

---
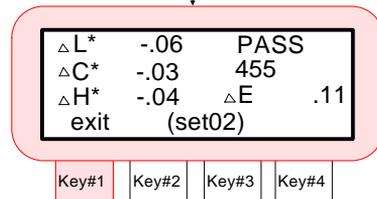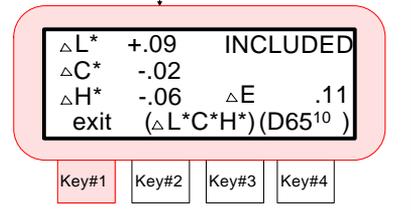
5) The last measurement data can be redisplayed by pressing [view] key #2.

☞ Measurements can be taken in the view if desired.
The "data group name" can be customized to meet your requirements in the QA-Master software package, or by scanning tags with optional bar code reader (see Sec. 5.2).

```
        DATA GROUP 1
STORED:    1
STORES REMAINING: 998
   menu  view  next  edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |
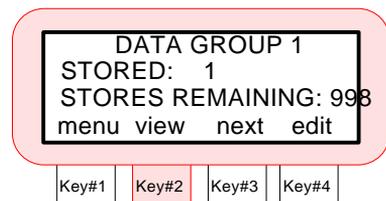
5.2 Tagging and Storing Operation (Optional)

☞ Tags are entered by scanning. If you intend to use the optional Bar Code Reader (BCR), we suggest that you read Section 9 before continuing with this tagging operation.

Tags are used as a method to label stored measurement samples for identification. The sample data can then be printed or uploaded to a software program (like X-Rite's QA-Master®) with tags applied.

Individual measurements can have from 1 to 6 tags attached. There are three tag options to select from once a tag is scanned.

Tag All - This option will only appear on the instruments display when no measurement data is stored in the instrument. Any measurement that is taken after "all" is selected will have the scanned tag attached.

Tag Group - This option will only appear on the instruments display when a new group is selected that has no stored measurements. Any measurement taken in that group after "group" is selected will have the scanned tag attached. The first tag that is scanned under group will also be used as the group name on the instrument.

Tag Next - This option will store the scanned tag with the next sample that is measured.

When the stored measurement data from the instrument is uploaded to X-Rite's QA-Master software program, all tags that were attached will also transfer.

To tag and store a measurement:

☞ Make sure that desired storage operation is selected in Operation Options, Sec. 7.2.

1) Press **[store]** key #4 at the **MENU PAGE 1** level to enter storage function.

```
          MENU PAGE 1

  pg2    norm    qc    store
```

Key#1   Key#2   Key#3   Key#4
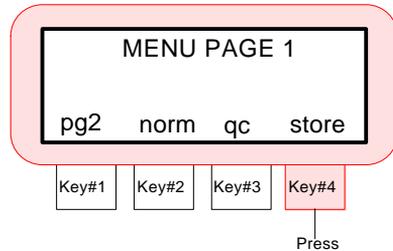
Press

2) This step only needs to be performed if **"STORE DATA WITH QC"** is selected in Operation Options (Section 7.2). Advance to Step 3 if "setup selection" is not required.

```
         DATA GROUP 1
STORED:    0
STORES REMAINING: 999
  menu   view   next   edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Select the "setup #" that will be used in sample storage mode.

- Press **[edit]** key #4 to enter **"SELECT EDIT OPTION"** menu.

```
      SELECT  EDIT OPTION

  exit    set01    del    print
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Sec. 5.3   Sec. 5.4

- Press **[set #]** key #2.

☛ If "setups" were downloaded from X-Rite's QA-Master software program, the entered name would appear above the **"SETUP = #."**

```
        SETUP = 01

  load   ↓ select ↑   define
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press

- Press [↓] key #2 to decrement and [↑] key #3 to increment through setup #'s.

- Press **[load]** key #1.
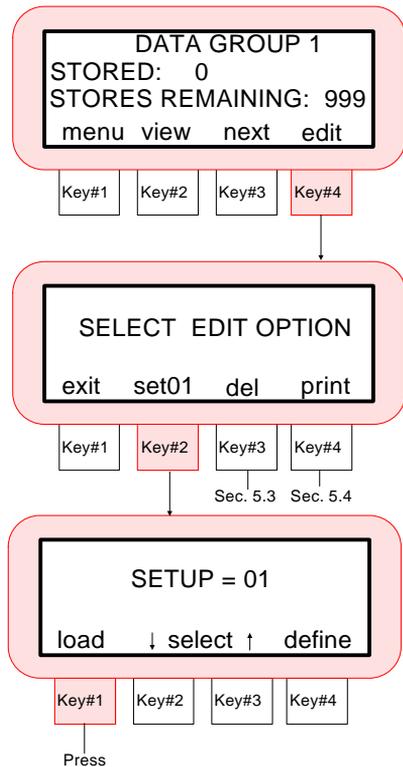
3) Select desired data group number (or name if downloaded from QA-Master) by repeatedly pressing the **[next]** key #3.

```
         DATA GROUP 1
STORED:    0
STORES REMAINING: 999
  menu   view   next   edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press
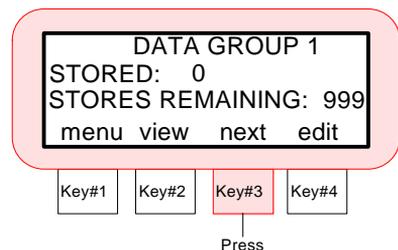
4) Connect Bar Code Reader to I/O
port if not already connected, and
scan the desired bar code. Refer to
Section 9 to attach or if scan did
not work correctly.
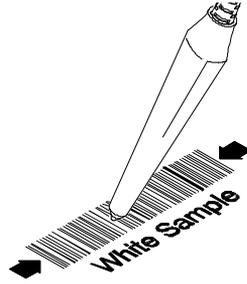
5) The bar code name should appear
on the first line of the display.

- Select desired tagging method.

- Press **[tag all]** if every measurement
that is to be stored will receive the
scanned tag.

☞   **"tag all"** will not appear if any measurements
have previously been stored.

- Press **[tag group]** if all measurements
in the selected group will have the
same scanned tag.

☞   If a group in not named and **"tag group"** is
selected, the scanned tag name will take the
place of the data group # on the first line of the
instrument display.
"tag group" will not appear if any
measurements have previously been stored in
the group.

- Press **[tag next]** if the measurement
to follow will be the only sample
with the scanned tag attached.

- A total of "6" tags can be attached
to each measurement. The total of
"6" tags includes combinations of
"all", "group", and "next" tag
selections.

```
        WHITE  SAMPLE
BARCODE  DATA  IS  FOR:
         tag    tag    tag
exit     all   group  next
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
        DATA GROUP 1
STORED:   0
STORES REMAINING: 999
 menu  view   next   edit
```

OR

```
        WHITE  SAMPLE
STORED:   0
STORES REMAINING: 999
 menu  view   next   edit
```

OR

```
        DATA GROUP 1
STORED:   0
STORES REMAINING: 999
 menu  view   next   edit
```
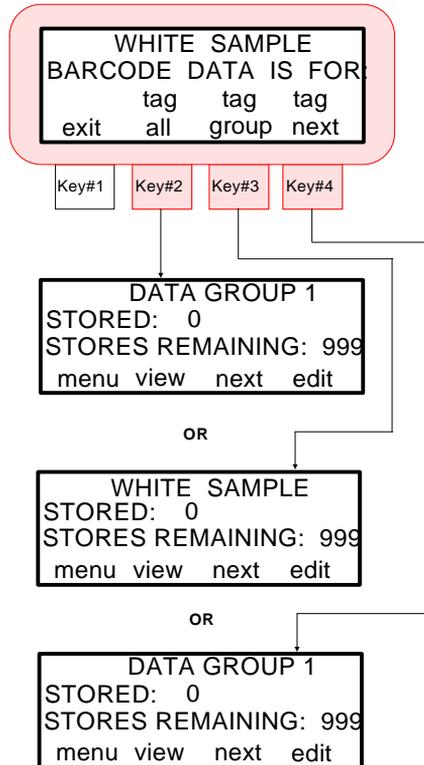
6) Scan additional bar codes if more are required for "all", "group", or "next" samples.
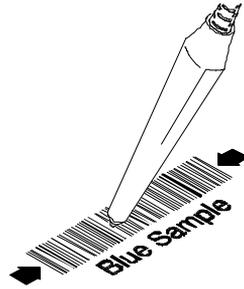
☞   If no tag method is selected before a measurement is taken, the instrument assumes a "next tag" selection.

7) Take measurement by lowering the unit to the target window on the sample.
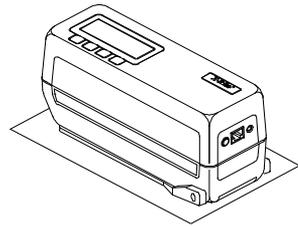
   - Lift unit off sample after **"READING COMPLETE"** indication is displayed.

☞   "Pass/Fail" indication will only display after **"READING COMPLETE"** if "Storage with QC" is activated (see Section 7.2).

```
      WHITE   SAMPLE
STORED:    1
STORES REMAINING: 998
menu  view   next   edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

OR ── **STORAGE WITH QC**

8) The measurement data can be redisplayed by pressing **[view]** key #2.

```
△L*   +.09      INCLUDED
△C*    -.02
△H*    -.06      △E      .11
 exit    (△L*C*H*) (D65¹⁰ )
```

| Key#1 | Key#2 | Key#3 | Key#4 |

9) Press the **[exit]** key #1 to return to the storage display.

10) Continue with additional tag storage measurements if required.

```
△L*    -.06       PASS
△C*    -.03        455
△H*    -.04      △E      .11
 exit    (set02)
```

| Key#1 | Key#2 | Key#3 | Key#4 |
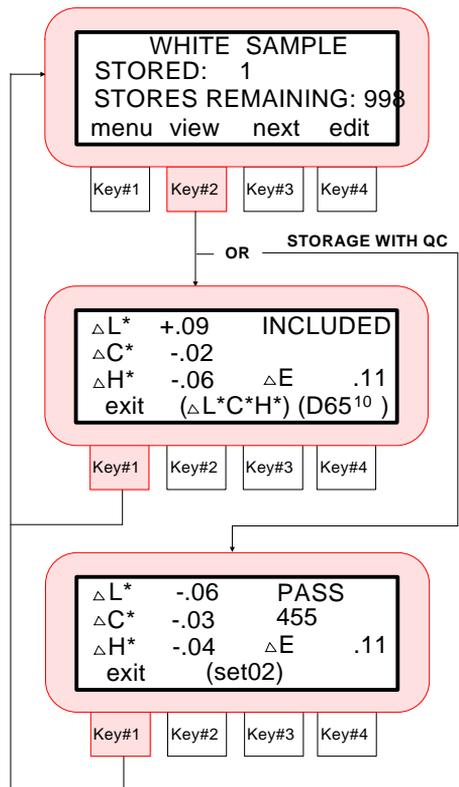
QA-Master Group and Setup Name Special Feature

The SP78 has a unique feature that allows the user to automatically switch to a "setup" or "group" that uses the same name as the scanned tag.

For example, if "setup #5" is named "Light Blue #6" and the scanned tag has the same name, the SP78 will display a "setup" key. Pressing this key allows you to switch to that setup if desired. Downloaded "group names" work in the same manner. A key named "group" will appear if a tag is scanned that has the same name as a downloaded group name.

```
┌─────────────────────────────┐
│   ┌─────────────────────┐   │
│   │   LIGHT BLUE #6      │   │
│   │                     │   │
│   │  setup   group   tag│   │
│   └─────────────────────┘   │
└─────────────────────────────┘
  ┌──────┐┌──────┐┌──────┐┌──────┐
  │Key#1 ││Key#2 ││Key#3 ││Key#4 │
  └──────┘└──────┘└──────┘└──────┘

Switch to Setup
        Switch to Group
            Places tag on next measurement
```
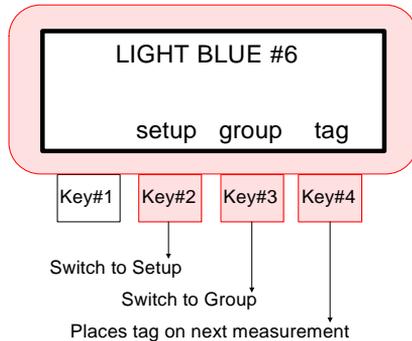
Pressing either of these keys will switch the display to the "setup" or "group" that has the same downloaded name.

The "tag" key that displays works in the same manner as "next tag." Pressing this key will store the scanned tag with the originally selected "setup" or "group."

☞ The "setup" key and "group" key will only appear if tags that are scanned have the same names as downloaded "group names" or "setup names."

QA-Master Sample Tagging Special Feature

Remotely measured samples have the ability to be assigned with Accept/Reject status using the BCR tagging option. Uploaded samples in QA-Master can be given the desired Accept/Reject status.

Notes:

* To assign a sample with Accept/Reject status, a tag must be scanned with the respective name before the measurement is taken.

* The sample status **ACCEPT**, **REJECT**, or **UNDETERMINED** must be scanned in as capital letters.

* If a sample is assigned both "**ACCEPT**" and "**REJECT**" status, the sample will be uploaded as "**UNDETERMINED**."

5.3 Editing Stored Measurements

There are three modes of operation that can be performed in editing.

* **Delete Last** - Allows only the last measurement taken in the selected group to be deleted from stored memory.

* **Delete Group** - Deletes all stored measurements in the selected group.

* **Delete All** - Causes all stored measurements in all twenty groups to be deleted.

To delete a measurement:

1) Press **[edit]** key #4 to enter the **"SELECT EDIT OPTION"** menu.

```
       DATA GROUP 1
STORED:   5
STORES REMAINING: 994
  menu   view   next   edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

2) Press the **[del]** key #3 to enter the **"SELECT DELETE MODE"** menu.

```
      SELECT EDIT OPTION

 exit   set01   del   print
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Sec. 5.4

 - Delete last, group, and all will be defined on the following pages.

```
          SELECT
       DELETE MODE

 exit    all   group   last
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Delete All
Delete Group
Delete Last
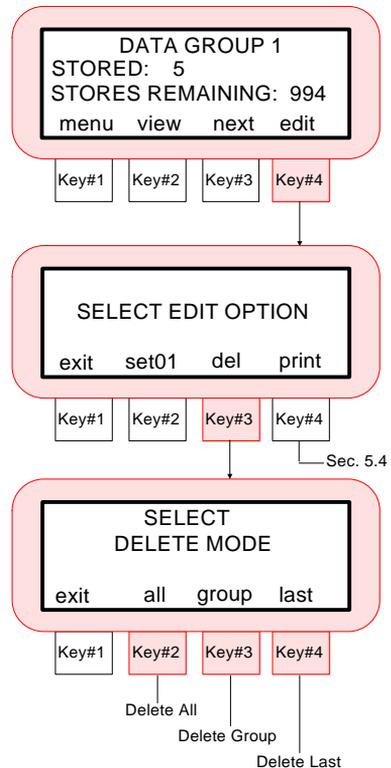
Delete Last

1) Press **[last]** key #4.

```
         SELECT
       DELETE MODE

   exit    all    group  last
```
| Key#1 | Key#2 | Key#3 | Key#4 |

2) Press **[↓]** key #2 or [↑] key #3 to
   select desired group number.
   - Press **[yes]** key #4 to delete last
   measurement in the selected group.

```
      DATA GROUP 1
   DELETE READING 5?

   exit    ↓ select ↑    yes
```
| Key#1 | Key#2 | Key#3 | Key#4 |

           Decrease   Increase

3) Press **[exit]** key #1 to return to the
   delete mode menu.

```
      DATA GROUP 1
   DELETE READING 4?

   exit    ↓ select ↑    yes
```
| Key#1 | Key#2 | Key#3 | Key#4 |
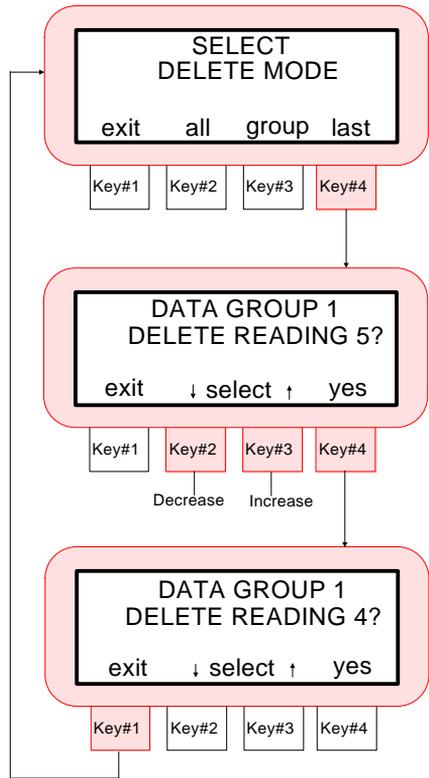
Delete Group

1) Press **[group]** key #3.

```
        SELECT
      DELETE MODE

 exit   all   group   last
```

Key#1	Key#2	Key#3	Key#4

2) Press [↓] key #2 or [↑] key #3 to select desired group number.

 - Press **[yes]** key #4 to delete selected group.

```
      DATA GROUP 1
  DELETE WHOLE GROUP?

 exit    ↓ select ↑    yes
```

Key#1	Key#2	Key#3	Key#4
	Decrease	Increase	

 - **"DATA GROUP # DELETED"** is displayed.

```
      DATA GROUP 1
        DELETED
```

3) Press **[exit]** key #1 to return to the delete mode menu.

```
      DATA GROUP 1
  DELETE WHOLE GROUP?

 exit    ↓ select ↑    yes
```

Key#1	Key#2	Key#3	Key#4
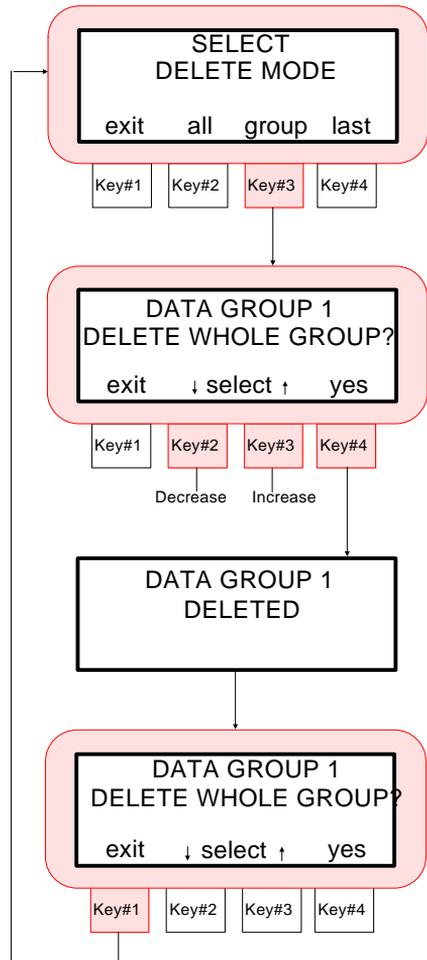
Delete All

1) Press **[all]** key #2.

```
┌─────────────────────────────┐
│         SELECT              │
│      DELETE MODE            │
│                             │
│  exit    all   group  last  │
└─────────────────────────────┘
  Key#1  Key#2  Key#3  Key#4
```

2) Press **[yes]** key #4 to clear all
   stored data in all groups.

```
┌─────────────────────────────┐
│                             │
│    DELETE EVERYTHING?       │
│                             │
│  no                   yes   │
└─────────────────────────────┘
  Key#1  Key#2  Key#3  Key#4
```

```
┌─────────────────────────────┐
│                             │
│     ALL DATA CLEARED        │
│                             │
└─────────────────────────────┘
```

- "**ALL DATA CLEARED**" is
  displayed.

- "**RESET GROUPS TO DEFAULTS?**"
  is displayed.

3) Press **[no]** key #1 to keep preset
   group names (i.e., names scanned
   with the bar code reader or set in
   QA-Master). Press **[yes]** key #4 to
   reset names to factory defaults
   (i.e., Data Group 1, etc.).

```
┌─────────────────────────────┐
│      RESET GROUPS           │
│      TO DEFAULTS ?          │
│                             │
│  no                   yes   │
└─────────────────────────────┘
  Key#1  Key#2  Key#3  Key#4
```

```
┌─────────────────────────────┐
│     ALL GROUPS              │
│   SET TO DEFAULTS           │
└─────────────────────────────┘
```

4) Press **[exit]** key #1 to exit edit
   mode.

```
┌─────────────────────────────┐
│         SELECT              │
│      DELETE MODE            │
│                             │
│  exit    all   group  last  │
└─────────────────────────────┘
  Key#1  Key#2  Key#3  Key#4
  Press
```
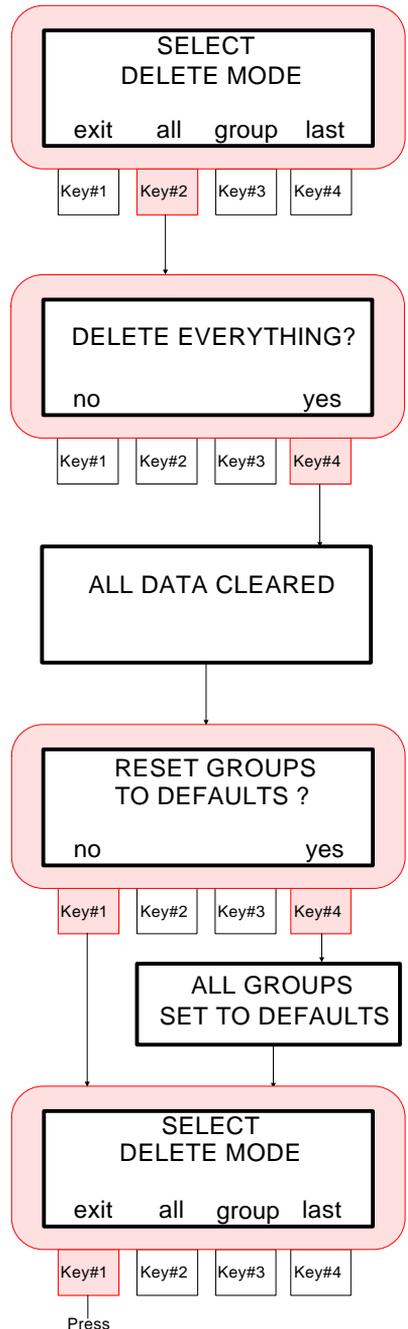
Exiting Storage Mode

To exit storage mode:

1) Press **[menu]** key #1 to enter **MENU PAGE 1** screen.

```
          DATA GROUP 1
STORED:     0
STORES REMAINING: 999
 menu  view   next  edit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

2) Press **[norm]** key #2 or **[qc]** key #3 to exit storage function.

```
          MENU PAGE 1


 pg2   norm   qc   store
```

| Key#1 | Key#2 | Key#3 | Key#4 |

- Normal measurements or QC measurements can now be taken without being stored in memory.

```
 L*  95.23     INCLUDED
 a*   -9.28
 b*   -7.47
menu L*a*b*  D65¹⁰  ref
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
△L*   +.27     PASS
△a*    .00     654
△b*   -.08    △E    .28
menu  func   set01  ref
```

| Key#1 | Key#2 | Key#3 | Key#4 |
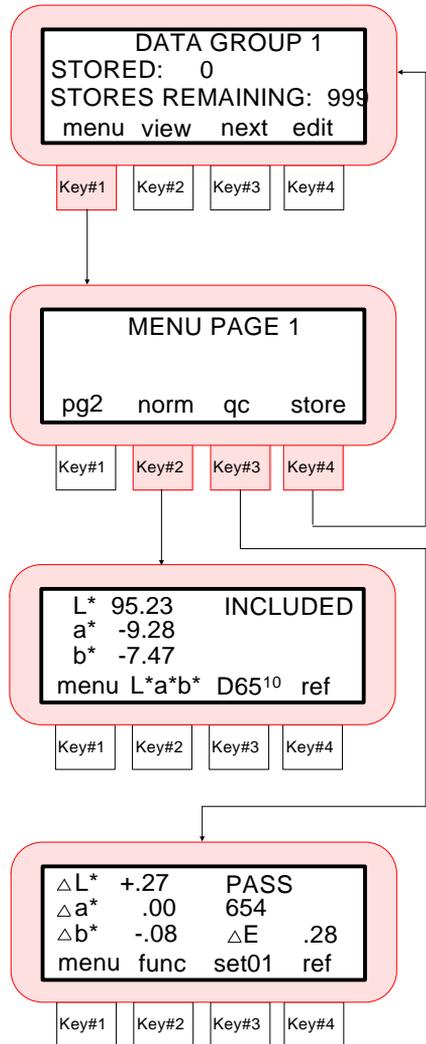
5.4 PRINTING STORED MEASUREMENTS

The SP78 has the ability to output stored measurement data directly to a serial printer or a computer. The printout options in Section 7.3 control what format data is to be output during a storage measurement printout. The measurement data that is printed depends on what **"STORAGE OPERATION"** was selected in Operation Options (Sec. 7.2).

To print stored measurements:

1) Refer to Section 7.3 to set RS-232 and Printout Options, if required.

2) In storage mode, press the **[edit]** key #4.

```
        DATA GROUP 1
STORED:    6
STORES REMAINING:  993
 menu   view   next   edit
```

Key#1   Key#2   Key#3   Key#4
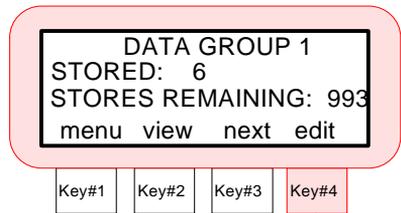
3) Press the **[print]** key #4 to enter the print mode option menu.

```
   SELECT  EDIT OPTION

exit           del   print
```

Key#1   Key#2   Key#3   Key#4
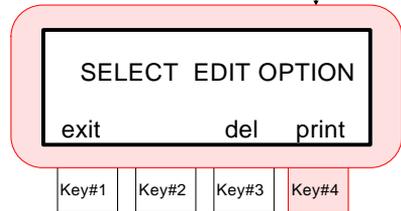
There are three modes of operation that can be accessed during stored data printout.

* **Print Last -** will print the data of the last measurement taken in the selected group.

* **Print Group -** will print all measurements that are currently in the selected group. The group printout function will also printout the "Group #" for each group that has data.

* **Print All -** all measurements that are stored will be printed.

```
       SELECT
     PRINT  MODE

exit    all    group   last
```

Key#1   Key#2   Key#3   Key#4

See Print All

See Print Group
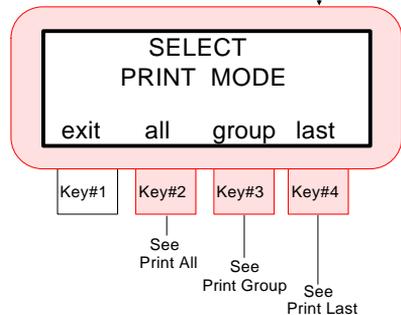
See Print Last

Print Last

1) Press **[last]** key #4 to enter print last
   mode.

```
        SELECT
      PRINT  MODE

  exit    all    group   last
```
| Key#1 | Key#2 | Key#3 | Key#4 |

2) Press the **[↓]** key #2 or **[↑]** key #3 to
   select desired group.
   - Press **[yes]** key #4 to print last
     measurement in the selected group.

```
      DATA GROUP 1
    PRINT READING 6?

  exit    ↓ select ↑    yes
```
| Key#1 | Key#2 | Key#3 | Key#4 |

Decrement Increment

3) **"PRINTING DATA"** is displayed and
   then the display returns to **DATA
   GROUP** menu.
   - Press the **[quit]** key #1 to stop printing.

```
      PRINTING  DATA

  quit
```
| Key#1 | Key#2 | Key#3 | Key#4 |

Stop Printing
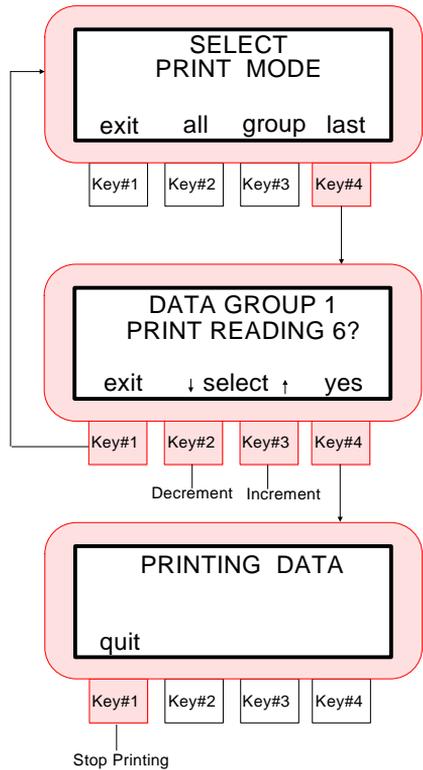
Print Group

1) Press **[group]** key #3 to enter print group mode.

2) Press the **[↓]** key #2 or **[↑]** key #3 to select desired group.
   - Press **[yes]** key #4 to print all measurement data in the selected group.

☞ If the **[↑]** key #3 is depressed one more time after **"DATA GROUP 20"** is displayed, **"PRINT ALL GROUPS ?"** will display. Selecting this option will printout all groups with existing measurement data.

3) **"PRINTING DATA # OF #"** is displayed until all data is printed, then the display will return to **DATA GROUP** menu.
   - Press the **[quit]** key #1 at any time to abort printing operation.

```
          SELECT
       PRINT  MODE

 exit    all    group   last
```

| Key#1 | Key#2 | Key#3 | Key#4 |

```
       DATA GROUP 1
   PRINT  WHOLE  GROUP ?

 exit    ↓ select ↑    yes
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Decrement Increment

```
       PRINTING  DATA
           1  OF  6

 quit
```

Key#1

Stop Printing

2 OF 6
3 OF 6
4 OF 6
5 OF 6
6 OF 6

Print All

1) Press **[all]** key #2.

```
          SELECT
       PRINT  MODE

 exit    all    group   last
```

| Key#1 | Key#2 | Key#3 | Key#4 |
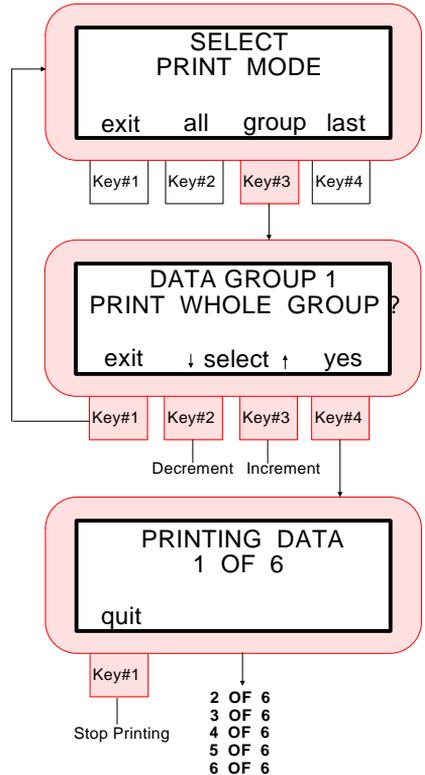
2) **"PRINTING DATA # OF #"** is displayed until all data is printed, then the display will return to **"SELECT PRINT MODE"** menu.
   - Press the **[quit]** key #1 at any time to abort printing operation.

```
       PRINTING  DATA
           1  OF  6

 quit
```

Key#1

Stop Printing

2 OF 6
3 OF 6
4 OF 6
5 OF 6
6 OF 6
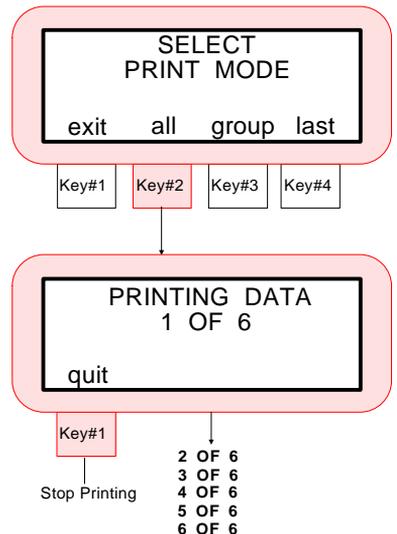
5.5 Run Job Programmability

"Run Job" function is used to activate a series of tagging and storing operations that can be programmed in the unit by X-Rite's QA-Master software package. A typical "job" would allow multiple information tags to be applied to each stored measurement. See the QA-Master users manual for further information.

"run job" will appear on **"MENU PAGE 2"** of the instrument once a job is downloaded. This key is used to activate the job.

```
        MENU PAGE 2


                          run
   exit    cal    cnfg    job
```
| Key#1 | Key#2 | Key#3 | Key#4 |
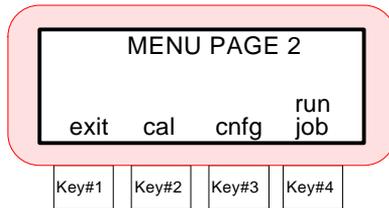
SECTION 6

CALIBRATION

Subjects covered in Section 6 are:

* 6.1 Positioning the Instrument on the White Calibration Standard
* 6.2 Positioning the Instrument on the Black Trap
* 6.3 Calibration Procedure

The SP78 should be calibrated to the X-Rite white standard and black trap the first thing each day and every four hours of operation thereafter (more frequently if measuring dark or high chroma colors). In any event, a **"NEED CALIBRATION"** message will appear in the display if:

* The calibration procedure has not been performed for 4 hours.
* A 5°C change in temperature has occurred since last calibration.
* Zero reflectance or white cal is measured improperly.

Whenever this message appears the calibration procedure should be performed before another measurement is taken to ensure accuracy.

Calibration Notes:
- Dirt or dust in the optics area will cause an inaccurate calibration reading. Refer to Section 8 Optics Cleaning.
- **The White Reflection Standard is dramatically affected by smudge marks, dust, and finger prints.** The standard should be cleaned periodically using a mild soap and warm water solution, thoroughly rinsed with warm water, and wiped dry with a lint free cloth. You must let the standard dry completely before taking a calibration reading. Return standard to its protective envelope.
- The black trap should be cleaned periodically to remove any dust or contamination that may have gotten in the tube. Clean the trap with compressed air or wipe with dry lint free cloth. Always store the black trap with the cap on the measurement opening.
- Do not move the SP78 while taking a calibration measurement. If motion is detected an error message will be displayed and calibration aborted.

6.1 POSITIONING THE INSTRUMENT ON THE WHITE CALIBRATION STANDARD

You must set the SP78 on the white standard so that the rubber pads on the bottom of the shoe reside on the standard, and the target is centered on the circle. If you do not, the unit will rock and cause an erroneous reading of the standard.

1) Center the target window on the White circle, making sure that the rubber pads are completely on the standard.
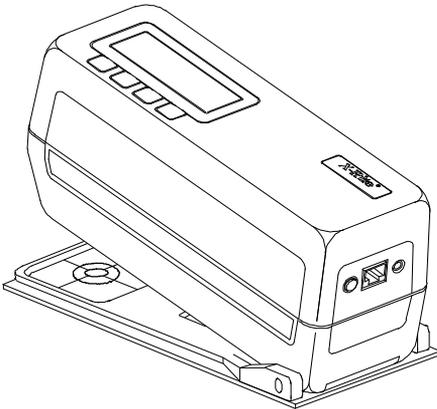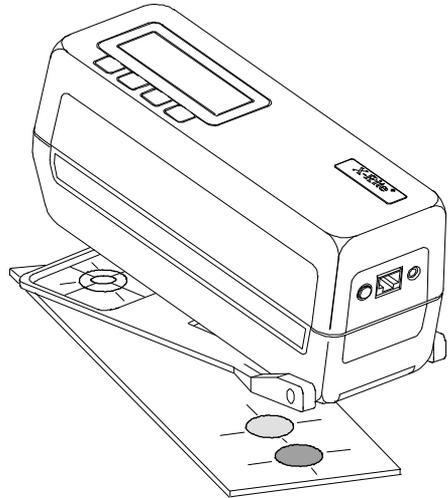
CORRECT!   **INCORRECT!**

2) Take the measurement.

X-Rite Reflection Standard
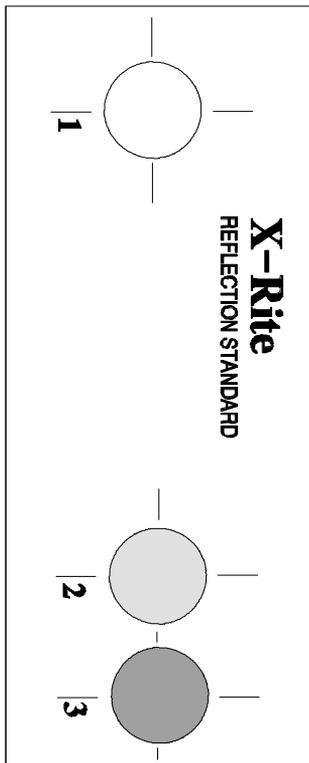
X-Rite
Reflection Standard
P/N SP68-62
Serial No. AXXXXXP-XXXXX
Date XX/XX/XX

WAVE [nm]	REFL [%]
390	56.48
400	75.42
410	82.04
420	86.10
430	87.20
440	87.14
450	87.56
460	87.97
480	88.49
500	88.95
520	89.13
540	89.02
560	88.78
580	88.34
600	87.80
620	87.32
640	86.98
660	86.55
680	86.10
700	85.62
710	85.18

CALIBRATION CHECK
D65/10 (WHITE)

L*

a*

b*

Instrument Model No.

Instrument Serial No.

COLOR CHECK
Refer to section in operation manual appendix for procedure to obtain reference values.

DATE: _____ TEMP: _____

ILLUM/OBS: _____ APERT: _____

REFERENCES VALUES

STEP	L*	a*	b*
1 (White)			
2 (Blue)			
3 (Brown)			

Notes: _____
_____
_____
_____

IMPORTANT!
The standard is dramatically affected by smudge marks and dust; and must be kept clean.

The Calibration Values for the white spot are affected by the environment and cleaning method of the standard.

If the white spot does not measure correctly, it could be that the unit needs to be calibrated; there is dust in the optics; or the standard has smudge marks or is dirty.

The ceramic standard should be cleaned using a mild soap and warm water solution, thoroughly rinsed with warm water, and wiped dry with a clean, lint free cloth.

6.2 POSITIONING THE INSTRUMENT ON THE BLACK TRAP

The aperture in the target window must be centered (as close as possible) over the black trap opening. Make sure that the base of the trap is setting on a flat, level surface. Any movement of the trap during measurement may cause an error message to display.

1) Center the aperture in the target window over the black trap by holding the outside edge of the shoe with your left hand.

Hold Here With Left Hand

Aperture
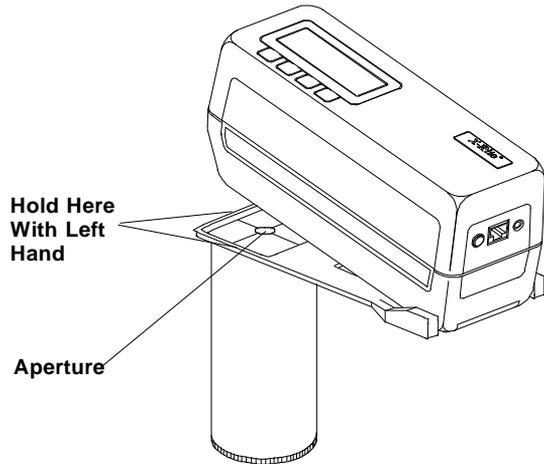
2) Lower the instrument to the shoe and hold until the measurement is taken.

☛ The black trap should be cleaned periodically with clean, dry compressed air. Or, wiped clean with a lint free cloth.

A **"WARNING! LARGE CHANGE CHECK FOR DUST"** error message will occur during zero reflectance measurement if dust is detected in the trap or optics, or if the instrument experiences normal drift. If the message appears, clean optics and black trap and measure zero again.
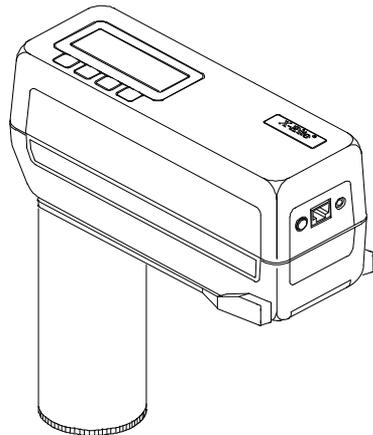
6.3 CALIBRATION PROCEDURE

To perform a calibration:

1) Make sure white cal standard and black trap are clean (see calibration notes Section 6).

2) Press **[menu]** key #1 twice to enter **MENU PAGE 2.**

```
L*     94.10    INCLUDED
C*     21.88
h°     193.97
menu  L*C*h°  D65¹⁰   dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press Twice
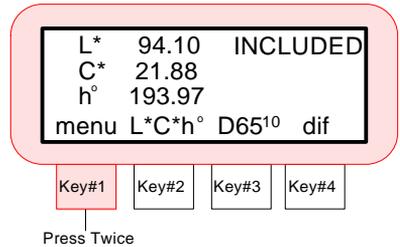
3) Press **[cal]** key #2 to enter calibration function.

```
        MENU PAGE 2



exit    cal    cnfg
```

| Key#1 | Key#2 | Key#3 | Key#4 |

 - The software datecode and copyright are momentarily displayed.

```
        CALIBRATION
        X-RITE SP78
        VERS. XXXX
     COPYRIGHT 1992
```

 - **"READ WHITE CALIBRATION PLAQUE"** is displayed.

☞ Pressing **[exit]** key #1 will abort the calibration procedure and calibration will not be updated.

```
        READ WHITE
    CALIBRATION PLAQUE

exit
```

| Key#1 | Key#2 | Key#3 | Key#4 |

⇨
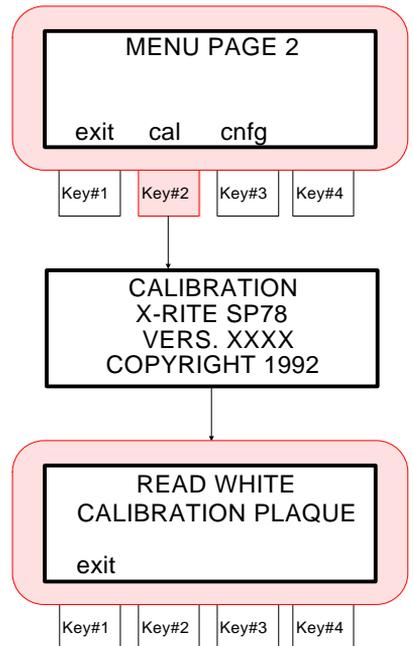
4) Position the instrument on the white standard and take measurement. Refer to Positioning the Instrument on the White Cal Standard Section for additional information.
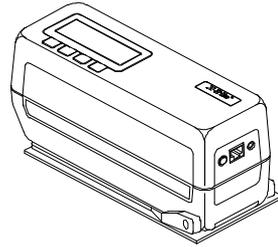
- **"READING WHITE PLAQUE"** is displayed, then **"READING COMPLETE."**

☞ If an error message occurs during calibration, try reading plaque again. If error message still occurs, refer to Display Messages in Appendix B.

- **"READ ZERO REFLECTANCE"** is displayed.
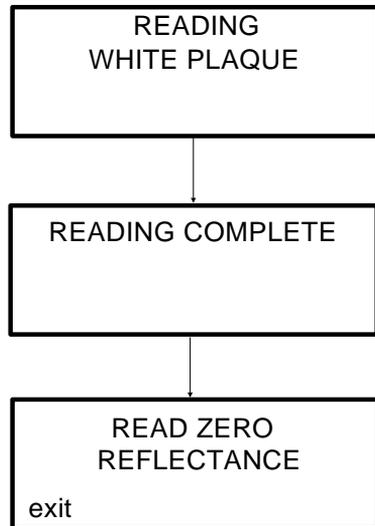
```
┌─────────────────────────┐
│        READING          │
│     WHITE PLAQUE        │
│                         │
│                         │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│    READING COMPLETE     │
│                         │
│                         │
│                         │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐
│       READ ZERO         │
│     REFLECTANCE         │
│                         │
│ exit                    │
└─────────────────────────┘
```

☞ The black trap should be cleaned periodically with clean, dry compressed air. Or, wiped clean with a lint free cloth.

A **"WARNING! LARGE CHANGE CHECK FOR DUST"** error message will occur during zero reflectance measurement if dust is detected in the trap or optics, or if the instrument experiences normal drift. If this message appears, clean optics and black trap and measure zero again.

5) Place the instrument over the black trap. Refer to Positioning the Instrument on the Black Trap Section.
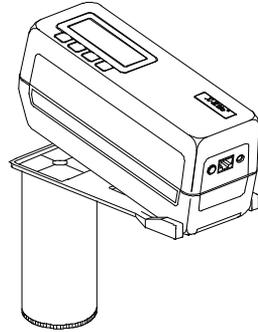
6) Lower the instrument to the target window to take measurement.
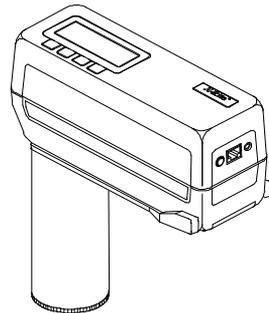
- **"READING ZERO REFLECTANCE"**
  "ZERO REFLECTANCE
  CALIBRATION UPDATED", and
  "WHITE CALIBRATION UPDATED"
  is displayed.

☞ If an error message occurs during the zero reflectance measurement, clean optics and/or black trap and try reading again. If error message still occurs, refer to Display Messages in Appendix B.

If **"PLEASE WAIT XX (1-30) SECONDS"** is displayed during calibration, continue to hold in down position until calibration reading is over. This will only occur if the calibration procedure is performed within 30 seconds of a previous measurement.

```
┌─────────────────────┐
│      READING        │
│  ZERO REFLECTANCE   │
│                     │
│                     │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ ZERO REFLECTANCE    │
│    CALIBRATION      │
│      UPDATED        │
│                     │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ WHITE CALIBRATION   │
│      UPDATED        │
│                     │
│                     │
└─────────────────────┘
```
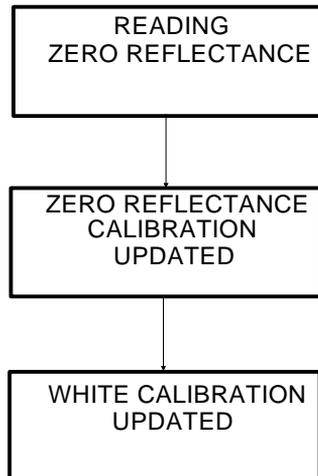
SECTION 7
SETTING SYSTEM CONFIGURATION

Subjects covered in Section 7 are:

* 7.1 Setting RS-232 Communication Options
* 7.2 Setting Operation Options
* 7.3 Setting Printout Options
* 7.4 Setting Date and Time

The system configuration allows you to customize the instrument to meet your application requirements. The configuration should be set before any measurements are taken.

7.1 SETTING RS-232 COMMUNICATION OPTIONS

The SP78 comes equipped with a serial port that allows data to be transmitted/received to/from an external device. Listed below are available I/O options.

Communication Emulation - allows the SP78 to emulate other instrument outputs. When set to OFF, the instrument communicates normally. When set to ON, alternate communication modes can be selected from a list of options. The factory default is "OFF."

Specific details on this feature are contained in publication SP68-602: "Sphere Spectrophotometer Instrument Emulation", available from your X-Rite representative.

Baud Rate - determines the input/output rate (characters per second) of the RS-232 port. Available outputs are: 300, 600, 1200, 2400, 4800, 9600, and 19200. The factory default setting is 9600 baud.

Line Feed Operation - varies the delimiter at the end of each line of data. When set to OFF, just a carriage return is sent at the end of a line of data. When set to ON, a carriage return then a line feed are sent at the end of the line of data. The factory default setting is LF with CR.

$\Rightarrow$

Handshake Operation - is used for data transmission. Handshake may be set to NO HANDSHAKE, PIN 5 is CTS SIGNAL, Pin 5 is BUSY SIGNAL, or XON/XOFF. Handshake should be set to "No Handshake" when not being used. The factory default setting is No Handshake.

To change the communication options:

1) Press **[menu]** key #1 twice to enter **MENU PAGE 2.**

```
L*    94.10    INCLUDED
C*    21.88
h°    193.97
menu L*C*h° D65¹⁰   dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press Twice

2) Press **[cnfg]** key #3 to enter configuration functions.

```
MENU PAGE 2


exit    cal    cnfg
```

| Key#1 | Key#2 | Key#3 | Key#4 |
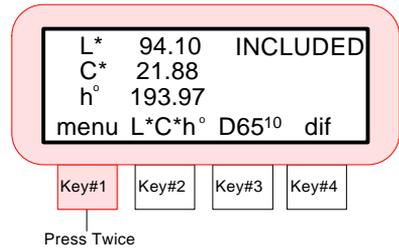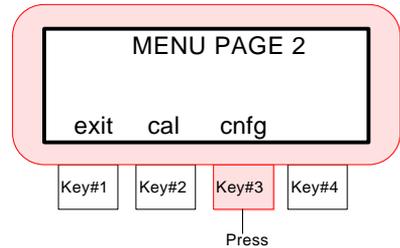
Press

3) Press the [↓] key #3 or [↑] key #4 to select Communication Options, then press **[yes]** key #2.
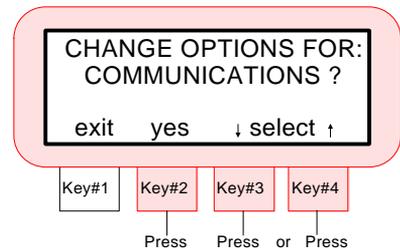
```
CHANGE OPTIONS FOR:
 COMMUNICATIONS ?

exit    yes    ↓ select ↑
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press   Press or Press

⇨

☞ On certain options the **[↓]** key #2 will page down through the available settings, while the **[↑]** key #3 will page up through the available settings.

4) Set communication emulation to On or Off. Press **[on]** key #2 to set **"EMULATION =ON"**, or press **[off]** key #3 to set **"EMULATION =OFF."**

☞ If emulation is set to **"ON"**, contact your X-Rite representative for specific setup details.

```
  ┌─────────────────────────┐
  │   COMMUNICATION         │
  │   EMULATION = OFF       │
  │                         │
  │ exit    on    off   next│
  └─────────────────────────┘
   Key#1   Key#2  Key#3  Key#4

            ON     OFF
```

5) Select the baud rate by pressing the **[↓]** key #2 or **[↑]** key #3. The available rates are: **"300", "600", "1200", "2400", "4800", "9600",** and **"19200."**

- Press **[next]** key #4 to advance to next option.

```
  ┌─────────────────────────┐
  │   I/0 PORT BAUD RATE =   │
  │       9600 BAUD          │
  │                         │
  │ exit   ↓ select ↑   next│
  └─────────────────────────┘
   Key#1   Key#2  Key#3  Key#4

          19200    300
           9600    600
           4800   1200
           2400   2400
           1200   4800
            600   9600
            300  19200
```

6) Set the line feed option to On or Off. Press **[on]** key #2 to set line feed (on), or press **[off]** key #3 to set **"no"** line feed (off).

- Press **[next]** key #4 to advance to next option.

```
  ┌─────────────────────────┐
  │ AUTOMATIC LINE FEED      │
  │ WITH EACH <CR> = ON      │
  │                         │
  │ exit    on    off   next│
  └─────────────────────────┘
   Key#1   Key#2  Key#3  Key#4

            ON     OFF
```

7) Select the handshake operation by pressing **[↓]** key #2 or **[↑]** key #3. The available options are: **"NO HANDSHAKE", "PIN 5 IS CTS SIGNAL", "PIN 5 IS BUSY SIGNAL",** and **"XON/XOFF."**

- Press the **[exit]** key #1 once to return to Communication Options main menu, or press key #1 twice to return to normal operation.

```
  ┌─────────────────────────┐
  │ HANDSHAKE OPTIONS =      │
  │    NO HANDSHAKE          │
  │                         │
  │ exit   ↓ select ↑   next│
  └─────────────────────────┘
   Key#1   Key#2  Key#3  Key#4

          No         Pin 5 CTS
          XON/XOFF   Pin 5 BUSY
          Pin 5 BUSY XON/XOFF
          Pin 5 CTS  No

            To Emulation Mode
```
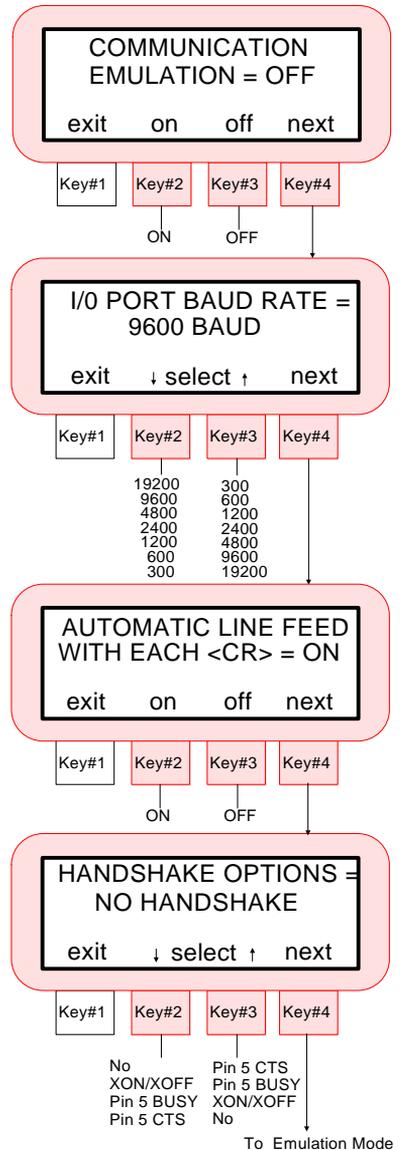
7.2 SETTING OPERATION OPTIONS

There are nine options that can be adjusted to meet your requirements. Listed below is a description of these options and the procedure to change their settings.

Set Averaging - allows from 1 to 16 measurements to be preset into memory. This will allow you to take as many measurements on a sample (up to 16) before an average value is calculated by the instrument. The average option can also be set to "auto averaging." Auto averaging ensures accuracy when measurements are very dark or of high chroma. Whenever an X, Y, or Z value of 2.5% or less is detected the instrument will automatically require three measurements. The three measurements will then be averaged into one value. "Auto Averaging" is set on at the factory and is the default setting.

☞ When averaging is set to "1", no averaging is performed and no averaging measurements will be displayed.

Auto Setup - when "auto setup" is enabled, the SP78 will automatically select the closest setup match when a sample is measured. The closest match is based on the "setup" reference and the selected illum/obs. Because illum/obs selection can vary between setups, a single illum/obs must be selected for "auto setup" operation. Once the closest match is found, the individual parameters (tolerance, illum/obs, etc.) of a setup will be used. Because a measured reference is generated from a reflectance curve, manual reference entry is not allowed when "auto setup" is activated.

☞ If any manual entered references exist in the instrument, a **"CLEAR HAND ENTERED REFERENCES"** message will display if you attempt to turn on Auto Setup. Manual references must first be cleared before "auto setup" can be activated.

Setup Limit - determines the number of "setups" that are available. Up to "50" setups can be selected. The factory default setting is "50."

Color Space Options - individual color spaces may be turned Off or On depending on your requirements. This allows only the color spaces you need to display during operation.

Select Illuminant/Observer - individual illuminant/observer pairs may be turned Off or On depending on your requirements. This allows only the illuminant/observers you use to display during operation.

Storage Operation - allows you to select which type of data will be stored during storage operation. When set to "Store Data Only", data from normal sample measurements will be stored in the instrument. When set to "Store Data with QC", data with QC setup functions will be stored in the instrument.

Sphere Geometry - determines if displayed data has the specular component included or excluded.

Delta Expression - When set to "Numbers", any L*a*b* or L*C*H* difference measurement will display deltas numerically. When set to "Words", any L*a*b* or L*C*H* difference measurement will display deltas as words (e.g., "brighter", "duller", ">>red", etc.).

Beeper Operation - determines the volume level that is output on the instruments beeper. Available settings are: "Soft" and "Loud."

To set the operation options:

1) Press **[menu]** key #1 twice to enter **MENU PAGE 2.**

```
L*    94.10    INCLUDED
C*    21.88
h°    193.97
menu  L*C*h°  D65^10   dif
```

| Key#1 | Key#2 | Key#3 | Key#4 |

Press Twice

2) Press **[cnfg]** key #3 to enter configuration functions.

```
            MENU PAGE 2


     exit    cal    cnfg
```

| Key#1 | Key#2 | Key#3 | Key#4 |
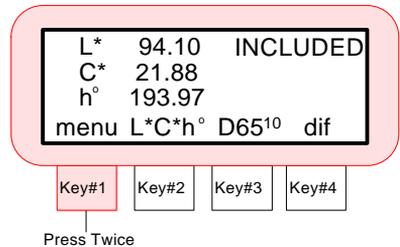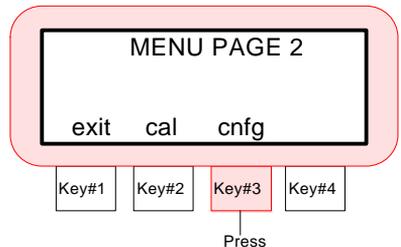
Press

3) Press the [↓] key #3 or [↑] key #4 to select Operation Options, then press **[yes]** key #2.

☞ On certain options the **[↓]** key #2 will page down through the available settings, while the

[↑] key #3 will page up through the available settings.

```
CHANGE OPTIONS FOR:
      OPERATION?

 exit    yes     ↓ select ↑
```

Key#1	Key#2	Key#3	Key#4
	Press	Press	or Press
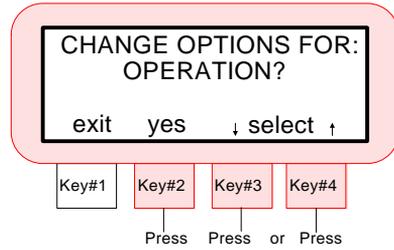
4) Select the number of averaged samples required (Auto or 1 - 16). Press the **[↓]** key #2 to decrement and the **[↑]** key #3 to increment average number. **Note:** Auto averaging is selected by pressing the [↓] key one time when **"1 SAMPLE AVERAGED"** is displayed.

- Press **[next]** key #4 to advance to the next option.

```
 AVERAGING MODE =
 AUTO  AVERAGED

 exit    ↓ select ↑    next
```

Key#1	Key#2	Key#3	Key#4
	Decrement	Increment	
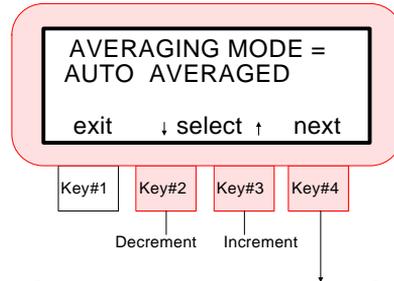
5) Select the auto setup option.
- Press **"Key #2"** to turn auto setup Off or On. If auto setup is turned on, press the **[sel]** key #3 to select illuminant/observer combination.

☞ If any manually entered references exist in the instrument, a **"CLEAR HAND ENTERED REFERENCES"** message will display if you attempt to turn on Auto Setup.

- Press **[next]** key #4 to advance to the next option.

```
 AUTO SETUP
    ILL/OBS  = D65¹⁰
    (OPTION  =  OFF)
 exit   off (on)  sel   next
```

$ILL/OBS = D65^{10}$

Key#1	Key#2	Key#3	Key#4
	on	C²	
	off	↓	
		D75¹⁰	
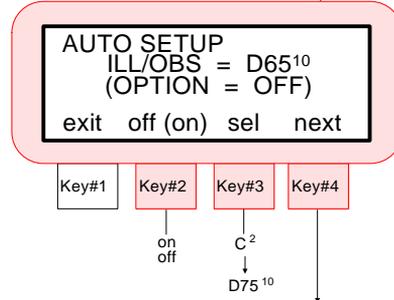
6) Select the number of setups required (1 - 50). Press the **[↓]** key #2 to decrement and the **[↑]** key #3 to increment setup number.

- Press **[next]** key #4 to advance to the next option.

```
 SETUP LIMIT  =
 50 SETUPS

 exit    ↓ select ↑    next
```

Key#1	Key#2	Key#3	Key#4
	Decrement	Increment	

Continued
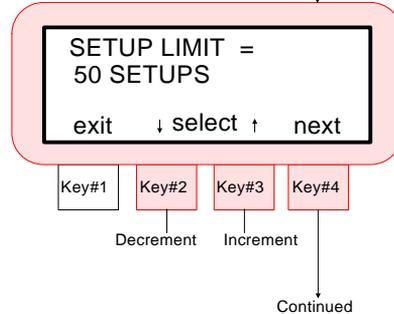
7) Select the color space you want to display.
 - Press **[sel]** key #3 to select color space and press **"Key #2"** to turn color space Off or On. A color space turned Off will not display during normal operation.

 - Press **[next]** key #4 to advance to the next option.

```
COLOR SPACE OPTIONS
    L*a*b*  IS  ON

exit   off (on)   sel    next
```

Key#1	Key#2	Key#3	Key#4
	off	L*a*b*	
	on	↓	
		△Ecmc	
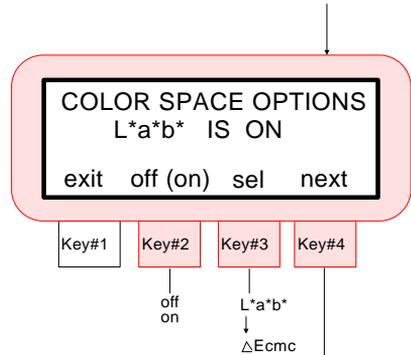
8) Select the illuminant/observer combinations you want to display.
 - Press **[sel]** key #3 to select illuminant/observer and press **"Key #2"** to turn illuminant/observer Off or On. An illuminant/observer turned Off will not display during measurement sequence.

 - Press **[next]** key #4 to advance to the next option.

```
ILL/OBS  OPTIONS =
      C ²  IS  ON
  (filtered  daylight)
exit    on      off    next
```

Key#1	Key#2	Key#3	Key#4
	off	C ²	
	on	↓	
		D75 ¹⁰	
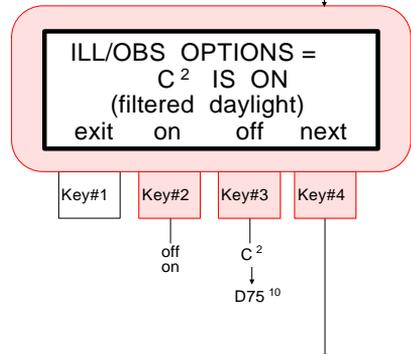
9) Select the storage operation by pressing the [↓] key #2 or [↑] key #3. The available settings are: **"STORE DATA ONLY"** and **"STORE DATA WITH QC."**

 - Press **[next]** key #4 to advance to the next option.

```
STORED OPERATION =
  STORE DATA ONLY

exit    ↓ select ↑    next
```

Key#1	Key#2	Key#3	Key#4
	ONLY	WITH QC	
	WITH QC	ONLY	
			Continued
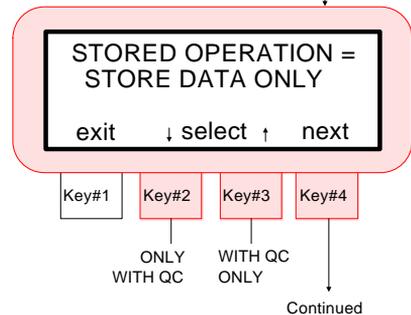
10) Select the sphere geometry by pressing the [↓] key #2 or [↑] key #3. The available settings are: **"INCLUDED"** and **"EXCLUDED."**

 - Press **[next]** key #4 to advance to the next option.

```
┌─────────────────────────────┐
│                             │
│   SPHERE GEOMETRY =         │
│   SPECULAR INCLUDED         │
│                             │
│   exit    ↓ select ↑   next │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4

INCLUDED · EXCLUDED (Key#2)   EXCLUDED · INCLUDED (Key#3)

11) Select the delta expression by pressing the [↓] key #2 or [↑] key #3. The available settings are: **"NUMBERS"** and **"WORDS."**

 - Press **[next]** key #4 to advance to the next option.

```
┌─────────────────────────────┐
│                             │
│   DELTA EXPRESSION =        │
│   NUMBERS                   │
│                             │
│   exit    ↓ select ↑   next │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4

NUMBERS · WORDS (Key#2)   WORDS · NUMBERS (Key#3)

12) Select the beeper volume by pressing the **[↓]** key #2 or **[↑]** key #3. The available settings are: **"SOFT"** and **"LOUD."**

 - Press the **[exit]** key #1 once to return to Operation Options main menu, or press key #1 twice to return to normal operation.

```
┌─────────────────────────────┐
│                             │
│   BEEPER OPERATION          │
│   VOLUME SOFT               │
│                             │
│   exit    ↓ select ↑   next │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4

LOUD · SOFT (Key#2)   SOFT · LOUD (Key#3)   To Averaging
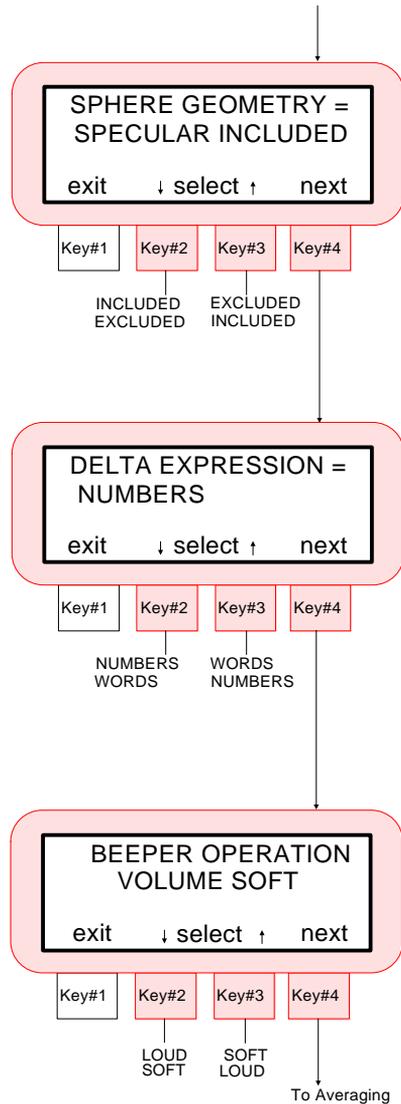
7.3 SETTING PRINTOUT OPTIONS

Setting the printout options will determine what information will be transmitted out the RS-232 port after a measurement. Listed below are the available options that can be set.

Printout Format - determines if the measurement data is output in "Spectral Data" (400nm - 700nm in 10nm increments), or "Color Space Data" (L*a*b*, etc.).

Header Operation - enables or disables the header (L*a*b*, etc.) from printing during a data transmit.

Reference Operation - enables or disables the reference data from printing (if any) during a data transmit.

To set printout options:

1) Press **[menu]** key #1 twice to enter **MENU PAGE 2.**

```
 L*    94.10    INCLUDED
 C*    21.88
 h°    193.97
menu  L*C*h°  D65¹⁰   dif
```

Key#1   Key#2   Key#3   Key#4

Press Twice

2) Press **[cnfg]** key #3 to enter configuration functions.

```
        MENU PAGE 2


exit    cal    cnfg
```

Key#1   Key#2   Key#3   Key#4

Press

⇨
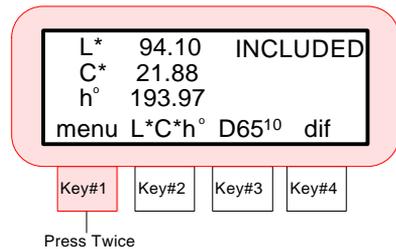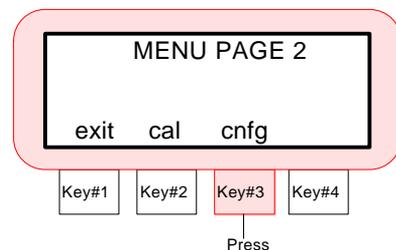
3) Press the **[↓]** key #3 or **[↑]** key #4 to select Printout Options, then press **[yes]** key #2.

```
┌─────────────────────────────┐
│  CHANGE OPTIONS FOR:        │
│        PRINTOUT?            │
│                             │
│   exit    yes    ↓ select ↑ │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4
	Press	Press or Press
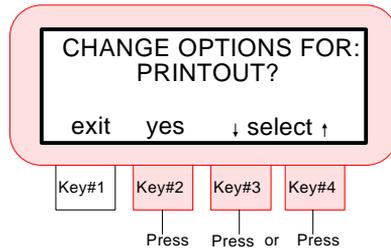
4) Select the printout format by pressing the **[↓]** key #2 or **[↑]** key #3. The available settings are: **"COLOR SPACE DATA"** or **"SPECTRAL DATA."**

 - Press **[next]** key #4 to advance to the next option.

```
┌─────────────────────────────┐
│  PRINTOUT FORMAT =          │
│     COLOR SPACE DATA        │
│                             │
│   exit    ↓ select ↑    next│
└─────────────────────────────┘
```

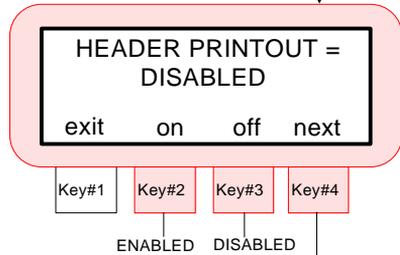| Key#1	Key#2	Key#3	Key#4
	COLOR SPACE	SPECTRAL	
	SPECTRAL	COLOR SPACE	
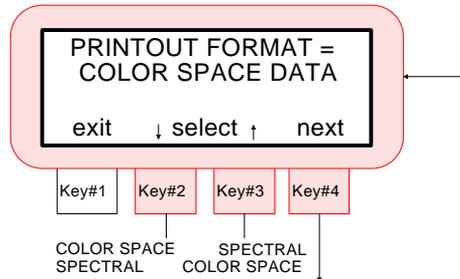
5) Set the header printout to Enabled or Disabled. Press **[on]** key #2 to print header (enabled), or press **[off]** key #3 to disable header print.

```
┌─────────────────────────────┐
│  HEADER PRINTOUT =          │
│       DISABLED              │
│                             │
│   exit    on    off    next │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4
	ENABLED	DISABLED	

6) Set the reference printout to Enabled or Disabled. Press **[on]** key #2 to print reference (enabled), or press **[off]** key #3 to disable reference print.

```
┌─────────────────────────────┐
│  REFERENCE PRINTOUT =       │
│       DISABLED              │
│                             │
│   exit    on    off    next │
└─────────────────────────────┘
```

Key#1	Key#2	Key#3	Key#4
	ENABLED	DISABLED	

 - Press the **[exit]** key #1 once to return to Printout Options main menu, or press key #1 twice to return to normal operation.

⇨
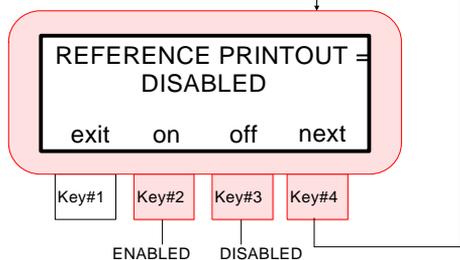
The following examples illustrate the different data output formats that can be obtained from the SP78 with a serial printer interfaced.

Example 1 - Color Space Format "ON"
Header "ON"
Reference "ON"

```
d(L*C*h)  D65_10  INCLUDED  13:09:56  12-21-92

  L      -.18  C     +.04  h       .00  E    .18

REF 01

  L    70.76  C      4.83  h    79.12
```

Example 2 - Color Space Format "ON"
Header "OFF"
Reference "OFF"

```
  L      -.18  C     +.04  h       .00  E   .18
```

Example 3 - Spectral Format "ON"
Header "ON"
Reference "OFF"

```
SPECTRAL  DATA  D65_10   INCLUDED   13:09:56  12-21-92
WAVELENGTH        VALUE
400               60.81
410               47.25
420               38.77
430               36.51
440               37.05
450               37.09
460               37.39
470               37.49
480               37.71
490               38.28
500               39.02
510               40.73
520               41.26
530               41.73
540               42.38
550               43.02
560               43.58
570               43.92
580               43.81
590               43.40
600               42.56
610               41.84
620               41.61
630               42.17
640               43.87
650               46.87
660               51.89
670               57.57
680               62.64
690               67.52
700               67.89
```
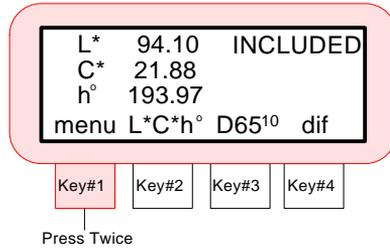
7.4 SETTING DATE AND TIME

The date and time function allows you to adjust the instruments internal clock. Eastern Time Zone is the factory default setting.

The date and time will be printed (if "Header" is On) with each measurement when data is output to a printer. Refer below for setting procedure.
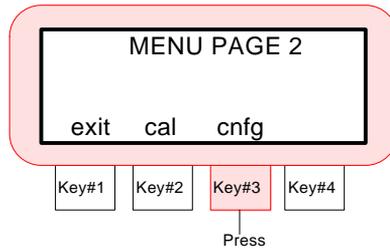
☛ If data is downloaded to the instrument from X-Rite's QA-Master software program, the instrument's clock will automatically be set to the computer's time and date.
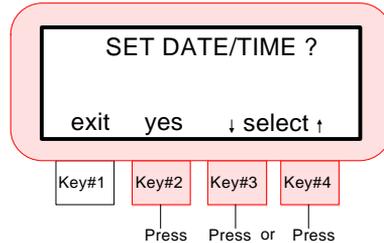
To set the date and time:

1) Press **[menu]** key #1 twice to enter **MENU PAGE 2.**

```
L*    94.10     INCLUDED
C*    21.88
h°    193.97
menu  L*C*h°  D65¹⁰   dif
```

Key#1   Key#2   Key#3   Key#4

Press Twice

2) Press **[cnfg]** key #3 to enter configuration functions.

```
           MENU PAGE 2


      exit    cal    cnfg
```
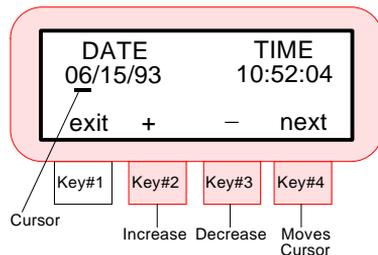
Key#1   Key#2   Key#3   Key#4

Press

3) Press the **[↓]** key #3 or **[↑]** key #4 to select Date/Time Option, then press **[yes]** key #2.

```
        SET DATE/TIME ?


   exit    yes      ↓ select ↑
```

Key#1   Key#2   Key#3   Key#4

Press Press or Press

4) Set Date and Time.

- Press **[next]** key #4 to move cursor to desired position on date or time.

- Press **[+]** key #2 to increase.

- Press **[-]** key #3 to decrease.

- Press the **[exit]** key #1 once to return to Date/Time main menu, or press key #1 twice to return to normal operation.

```
      DATE          TIME
     06/15/93      10:52:04

     exit    +      −     next
```

Key#1   Key#2   Key#3   Key#4

Cursor   Increase Decrease Moves Cursor

SECTION 8
GENERAL MAINTENANCE

Subjects covered in Section 8 are:

* 8.1 Cleaning the instrument
* 8.2 Cleaning the optics
* 8.3 Replacing the Battery Pack
* 8.4 Replacing the Target Window
* 8.5 Reading Lamp Replacement Information
* 8.6 Troubleshooting Tips

The X-Rite SP78 is covered by a one year limited warranty (excluding battery pack) and should be referred to the factory or authorized service center for repair within the warranty period. Attempts to make repairs within this time frame may void the warranty.

X-Rite provides a factory repair service to their customers. Because of the complexity of the circuitry all circuit repairs should be referred to the factory or an authorized service center.

X-Rite will repair any SP78 past warranty. Shipping costs to the factory or to an authorized service center shall be paid by the customer and the instrument shall be submitted in its original carton, as a complete unaltered unit.

8.1 CLEANING THE INSTRUMENT

The exterior of the instrument may be wiped clean with a cloth dampened with water or a mild cleaner whenever required.

CAUTION: DO NOT use any ketone solvents to clean the unit. This will cause damage to the cover.

8.2 CLEANING THE OPTICS

The optics should be cleaned once a week in normal environments, and more often in dirty or dusty environments.

1. **Unplug the AC adaptor and turn the power switch Off.**

2. Carefully lift the instrument up and blow short bursts of clean, dry air into the optics opening. This should remove any accumulated dust in the optics area.


WARNING:
- **Do not invert air cans that use freon as a propellant. Doing so could cause damage to the optics assembly.**
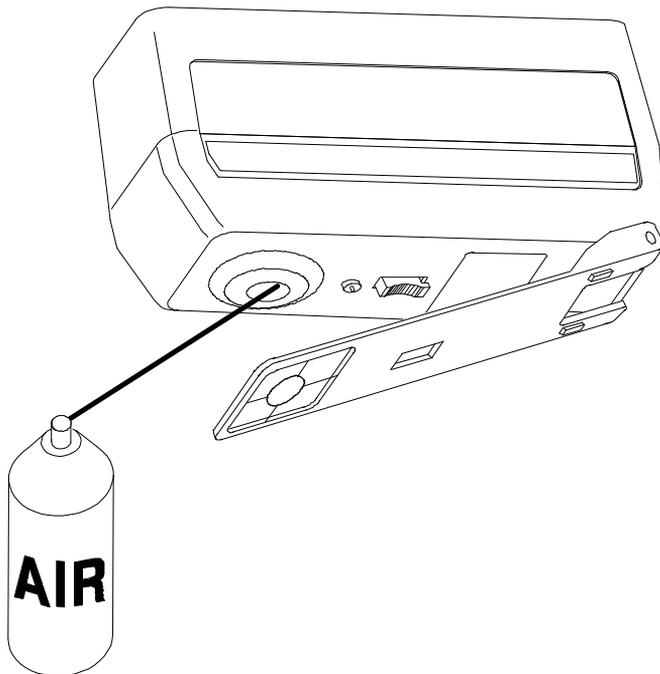
8.3 REPLACING THE BATTERY PACK

1. **Unplug the AC adaptor and turn the power switch Off.**

2. Carefully place the instrument on it's top and lock the shoe next to instrument.

3. Remove battery access cover by sliding towards rear of unit.

4. Grasp plastic tab that extends from battery pack and pull until pack is removed.

5. Slide new (or charged) battery pack into instrument until connector is properly seated.

6. Reinstall battery access cover by sliding into position.

7. Discharged battery packs should be charged in the instrument for 16 hours.

Battery Access Cover

Battery Pack

Connector
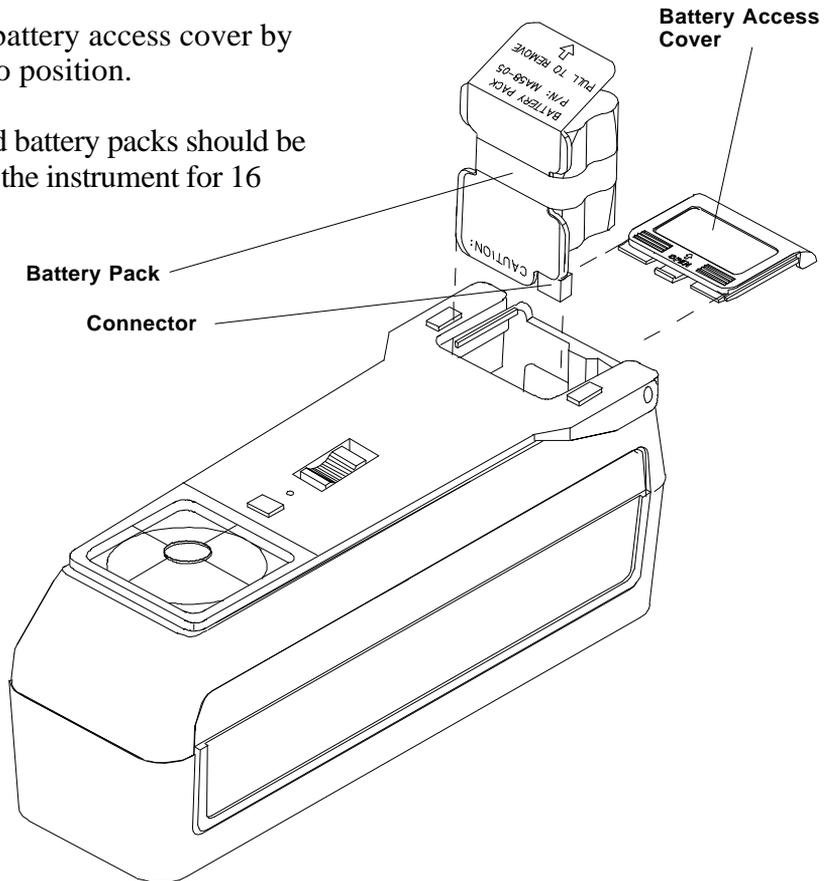
8.4 REPLACING THE TARGET WINDOW

Refer to Figure 1
1. **Unplug the AC adaptor and turn the power switch Off.**

2. Carefully place instrument on end and remove old target window **[1]** by pushing outward from inside of shoe **[2]**. Clean off any remaining adhesive from shoe **[2]**.

3. Insert target window alignment plug **[3]** into sensor nose **[4]**.

Refer to Figure 2
4. Compress shoe **[2]** all the way down and lock in position.

5. Remove paper backing **[5]** from adhesive on new target window **[1]**.

6. Place target window hole over alignment plug **[3]** and align crosshairs **[6]** squarely with shoe **[2]**.

7. Remove clear protective backing **[7]** from target window **[1].**

8. Unlock shoe **[2]** and remove alignment plug **[3]**.
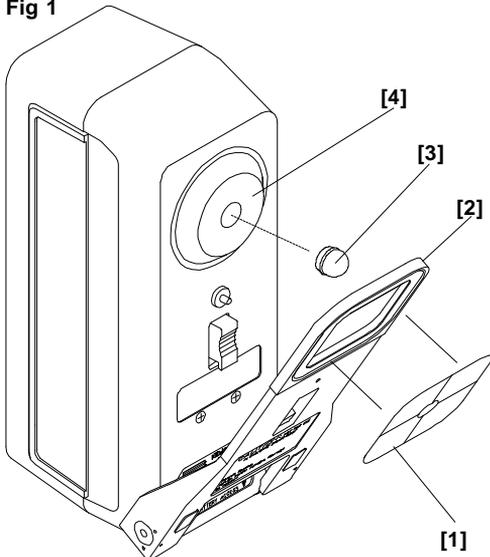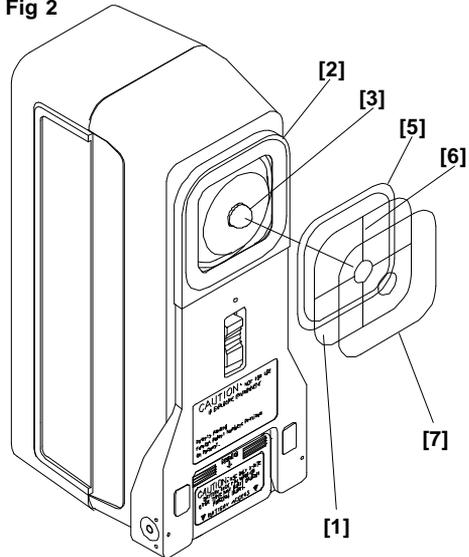
Fig 1   Fig 2

Replacement Target Window   SP68-21-04 (Small)   SP68-21-08 (Standard)   SP68-21-14 (Large)

8.5 READING LAMP REPLACEMENT INFORMATION

Due to the circuit complexity, critical alignment procedures, and test equipment required - **The read lamp should only be replaced by X-Rite or an authorized X-Rite Service Center.**

The lamp is monitored for intensity, and failure warnings will be displayed if a problem occurs.

The lamp should last approximately 500,000 measurements and is covered by a one year limited warranty. Refer to the Limited Warranty statement on page iii.

8.6 TROUBLESHOOTING TIPS

Instrument will not turn On (on display):
- * Power switch off (battery operation only).
- * Batteries are very low and in need of charge.
- * Contact X-Rite or Authorized Service Center.

Instrument will display but not measure:
- * Battery pack not installed.
- * Contact X-Rite or Authorized Service Center.

Incorrect measurement data continually displays:
- * Check standard material.
- * Calibrate instrument (see Sec. 6).
- * Clean optics (see Sec. 8).
- * Contact X-Rite or Authorized Service Center.

Measurement drifts:
- * Clean optics (see Sec. 8).
- * Calibrate instrument (see Sec. 6).
- * Contact X-Rite or Authorized Service Center.

Instrument will not calibrate properly:
- * Calibration standard needs to be cleaned (see Sec. 6).
- * Clean optics (see Sec. 8).
- * Contact X-Rite or Authorized Service Center.

SECTION 9

BAR CODE READER (Optional)

Subjects covered in Section 9 are:

* 9.1 Attaching SP78-200 Bar Code Reader to an Instrument
* 9.2 Scanning a Bar Code
* 9.3 Troubleshooting

The Optional SP78-200 Bar Code Reader is used to scan bar codes. When the BCR is used in conjunction with an X-Rite instrument, a scanned bar code becomes a tag for the measurement(s) taken with the instrument. When the data is uploaded into a software program (e.g., QA-Master®) the bar code tag(s) become sample tag(s).

9.1 ATTACHING THE SP78-200 BCR TO THE INSTRUMENT

Attach the BCR to the instrument's I/O Port. The instrument must be operating in the Storage mode before the BCR will operate.

To attach the SP78-200 BCR:

1) Insert the connector on the BCR into the I/O port of the instrument until it locks, usually indicated by an audible click. The connector inserts in one direction, (tab up) *DO NOT FORCE.* See Figure 1.

Figure 1

2) Power the instrument up, "**BAR CODE READER DETECTED**" will appear on the instrument display if the BCR is properly attached.
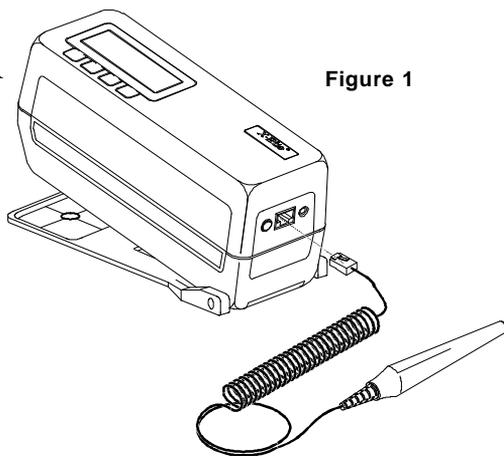
To disconnect the SP78-200 BCR:

1) Depress the tab on the connector and remove the connector from the instrument.

9.2 SCANNING A BAR CODE

Follow these guidelines for successful bar code scanning.

1) Turn on the X-Rite instrument. Be sure the instrument is in the Storage mode.

2) Hold the BCR in your hand as you would a pencil. The BCR works best when tilted from 10° to 30°, although any angle from 5° to 45° will work. See Figure 2.

(5° - 45°)
Operating
Angle

(10° - 30°)
Optimum
Operating
Angle
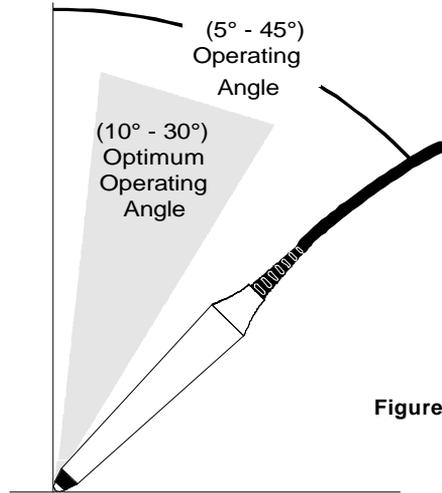
Figure 2

3) Place the tip of the BCR on the white space to the left or right of the bar code. Drag the BCR smoothly and lightly across the bar code. Do not lift the tip of the BCR from the surface of the bar code. See Figure 3.

4) The instrument will display the title of the bar code if the scan was successful. If the display appears blank try scanning the bar code again. If after several scanning attempts the display still appears blank, see Section 9.3, Troubleshooting.

White Sample

Figure 3

9.3 TROUBLESHOOTING

The factory default mode can be restored if the SP78-200 BCR is placed into an unusable or unknown configuration.

To restore the factory default mode:
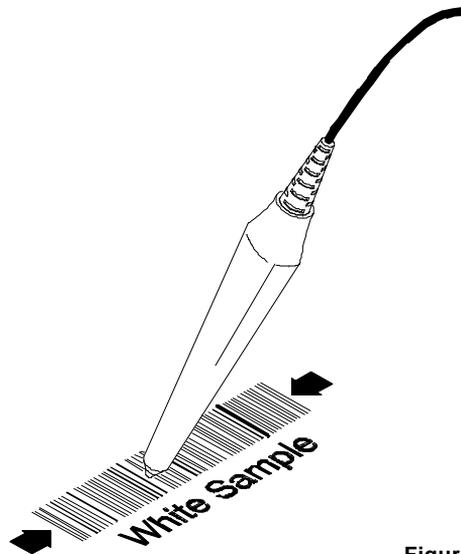
1) Disconnect the BCR from the instrument.

2) Reconnect the BCR to the instrument.

3) Scan the default configuration bar codes shown in the SP78-200 Bar Code Reader Instruction Sheet (P/N SP78-510).

Does the SP78-200 BCR have power?

* A red light will be visible at the tip of the BCR if it has power.
* Check the connection between the BCR and the instrument. Be sure the connector is correctly inserted.
* Check the power supply for the instrument. Refer to the instrument User's Manual, Troubleshooting section if the instrument does not have power.

Is the SP78-200 BCR configuration correct?

To restore the factory default mode:

1) Disconnect the BCR from the instrument.

2) Reconnect the BCR to the instrument.

3) Scan the default configuration bar code.

Does the SP78-200 BCR wavelength of light match the bar code?

The BCR will not read bar codes that are designed to be secure (black on black.) The optical signal returning from the bar code is not adequate for measuring the bars and spaces.

Is the SP78-200 BCR being held at the correct angle?

The BCR will operate when held at an angle of 5° to 45°. The optimum operating angle is from 10° to 30°.

Was the entire bar code scanned?

* Drag the BCR through the entire bar code at a constant speed. Increase the scanning speed. Typically the BCR is moved too slowly.

* Be sure the BCR scans the entire bar code.

* Be sure the BCR maintained contact with the surface of the bar code.

* Be sure the bar code is not damaged, dirty or worn. Try to scan an area without these defects.

Does the SP78-200 BCR tip need replacement?

If the tip becomes damaged or shows signs of excessive wear, it must be replaced.

To replace the tip:

1) Disconnect the BCR from the instrument.
2) Unscrew the tip from the wand.
3) Replace using part number SE124-01-01.

APPENDIX A

TECHNICAL SPECIFICATIONS

Measuring Geometries:
- » d/8°
- » Fiber optic pick-up with multi-sensor array
- » SP78S - Small Area View (5mm illumination / 4mm viewing)
- » SP78 - Standard Area View (11mm illumination / 8mm viewing)
- » SP78L - Large Area View (18mm illumination / 16mm viewing)

Light Source:
- » Gas-filled tungsten lamp, approx. 3000°K

Illuminant Types:
- » C, D_{65}, D_{50}, A, F2, F7, F11, F12, & D75

Standard Observers:
- » 2° & 10°

Measurement Functions:
- » Pass/Fail, 555 Shade Tag, and Pass/Fail & 555 based on: L*a*b*, L*C*h°, XYZ, Lab (Hunter), Whiteness per CIE and ASTM E313, Yellowness per ASTM E313 and D1925, Yxy, ΔL*a*b*, ΔL*C*H*, ΔXYZ, ΔLab (Hunter), ΔWht, ΔYel, ΔYxy, ΔE*, & ΔEcmc

Receiver:
- » Blue enhanced silicon photodiodes

Spectral Range:
- » 400nm - 700nm

Spectral Interval:
- » 20nm - measured (15nm bandwidth)
- » 10nm - output

Measurement Range
- » 0% - 200% Reflectance

Measuring Time:
- » Approx. 2.5 seconds

Inter-instrument Agreement:*
- » 0.20 ΔE*ab, based on average of 12 BCRA series II tiles
- » 0.40 ΔE*ab max on any tile

Short Term Repeatability:
- » 0.05 ΔE*ab (SP78, SP78L)
- » 0.10 ΔE*ab (SP78S)
  20 measurements on white calibration reference at 5 second intervals.

   * Specular component included with similar measurement area.

Lamp Life:
» Approx. 500,000 measurements

Power Supply:
» Six rechargeable AA Ni-metal hydride batteries included Removable battery pack; 7.2VDC rated @ 1100mAh

AC Adaptor Requirements:
» SP78: 90-130VAC, 50-60Hz, 18W Max
» SP78X: 180-260VAC, 50-60Hz, 20W Max
12VDC @ 700ma: Positive Tip

Charge Time:
» In Instrument - 4 hours (50%), 16 hours (100%)
» External Pack - Approx. 16 hours

Measurements per charge:
» 500 measurements

Data Interface:
» Patented bi-directional RS-232, 300-19200 baud

Display:
» 4-row by 20 character supertwist dot matrix LCD

Operating Temperature Range:
» 10°C to 40°C (50°F to 104°F)
» 85% relative humidity maximum (non-condensing)

CAUTION: This instrument is not for use in explosive environments.

Storage Temperature Range:
» -20°C to 50°C (-4°F to 122°F)

Weight:
» 1.4kg (3lbs. 2oz.)

Dimensions:
» Height - 11.6cm (4.56 in)
» Width - 7.62cm (3.0 in)
» Length - 22.5cm (8.85 in)

Accessories:
» Carrying Case
» Calibration Standard
» Operation Manual
» Black Trap
» AC Adaptor

Specifications and design subject to change without notice
X-Rite standards are traceable to National Research Council Canada, Laboratory for Basic Standards.

APPENDIX B

DISPLAY MESSAGES

The most likely reasons for error messages to display are described below. If an error message is consistently displayed, contact X-Rite or an Authorized Service Center.

Measurement Error Messages

"INVALID READING - BATTERIES VERY LOW, MUST BE CHARGED"- indicates batteries are too low to operate the unit. Plug in charger and wait 5 minutes before attempting to take accurate measurements.

"INVALID READING - LIGHT LEAKAGE"- stray light is getting into measurement aperture. Make sure surface being measured is flat.

"INVALID READING - MAXIMUM REFLECTANCE EXCEEDED"- surface measured is greater than the maximum range of the instrument (300%).

"INVALID READING - RESET DURING READ, CHECK BATTERIES"- this message may appear if the instrument is stored for an extended period of time. Recharge the batteries for 16 hours. If batteries are not charged after 16 hours, replace battery pack.

"INVALID READING - SWITCH RELEASED TOO SOON"- read switch was not held closed during entire reading. Try taking reading again.

Calibration Error Messages

"CALIBRATION ERROR ####"- calibration requires that the instrument remains motionless during the white cal. If the error persists and is not due to movement, the number that is displayed should be reported to X-Rite or an authorized service center.

"NEED CALIBRATION - DUE TO ABORTED CAL, READ WHITE"- the user aborted the calibration procedure during measurement sequence.

"NEED CALIBRATION - DUE TO BAD ZERO CAL"- zero reflectance calibration measurement was not properly updated.

"NEED CALIBRATION - DUE TO TEMPERATURE, READ WHITE"- a 10°C change in temperature occurred since the last calibration.

Calibration Error Messages - continued

"NEED CALIBRATION - DUE TO 4 HOUR FLAG, READ WHITE"- a
calibration procedure has not been performed for 4 hours.

"WARNING! - LARGE CHANGE, CHECK FOR DUST"- indicates excessive
dust was detected in the optics or black trap, or internal drift of
components occurred during a zero calibration. If this message does
occur, check for dust in the optics or black trap. If no dust is present the
message may indicate normal instrument drift.

Miscellaneous Error Messages

"BAR CODE RECEIVED - WHILE NOT IN STORE MODE" -Indicates that a
bar code was scanned when the instrument was not in storage mode.

"BATTERY LOW" - indicates that the batteries are getting low and will soon
need to be charged. It will only be displayed while the measurement is in
progress. The instrument will still take accurate measurements.

"LAMP FAILURE - LAMP MUST BE REPLACED"- the lamp intensity is too
weak for accurate measurements. The lamp should only be replaced by
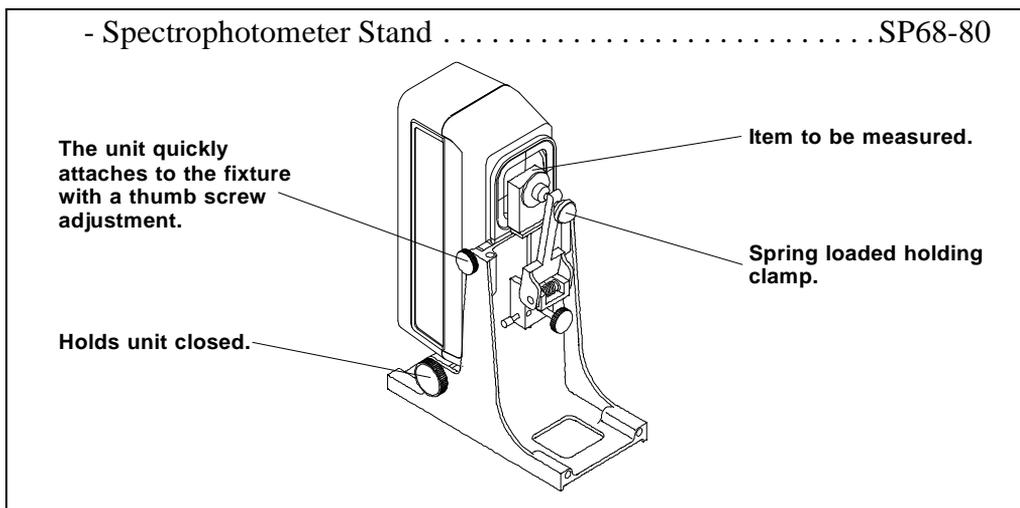X-Rite or an authorized service center.

"LAMP WARNING - REPLACE LAMP SOON"- the lamp is marginal and
should be replaced as soon as is conveniently possible.

- SP78-200 Bar Code Reader SP78-200

- Battery Pack Assembly MA58-05

- QA-Master® Software Package 1255-00

- Portable Thermal Printer (115VAC) 418-113

- Portable Thermal Printer (230VAC) 418X-113

- Interconnect cable for Macintosh computers
  with 8 pin mini-DIN connector 418-79

- Modular Interconnect Cable (requires adaptor below) SE108-69

- DB25P DCE (Null Modem) Interface Adaptor 418-70

- DB25S DCE (Null Modem) Interface Adaptor 418-71

- DB25P DTE (Normal) Interface Adaptor 418-80

- DB25S DTE (Normal) Interface Adaptor 418-81

- DB9P Interface Adaptor 418-90

- DB9S Interface Adaptor 418-91

- Spectrophotometer Stand SP68-80

The unit quickly attaches to the fixture with a thumb screw adjustment.

Item to be measured.

Spring loaded holding clamp.

Holds unit closed.

The color check procedure will help you track instrument color performance to assure measurement accuracy. Initially, the three patches on the standard should be measured once a day for a period of 10 days to determine the reference values. Thereafter, a periodic check (once a week depending on usage) is all that is required.

Located on the back of the reference standard envelope is a color check label. The reference data should be recorded there for quick reference.

Reference Data Procedure

To obtain reference values:

1) Clean instrument optics and reference standard if necessary.

2) Calibrate instrument according to procedure in operation manual.
   Note: The reference standard is dramatically affected by smudge marks and dust; and must be kept clean.

3) Select L*a*b* absolute function and desired illuminant/observer. **Note:** The selected illum/obs must be the same whenever the color check is performed.

4) Measure the White (1), Blue (2), and Brown (3) patches on the reference standard.

X−Rite
REFLECTION STANDARD

| 1 | | 2 | 3 |
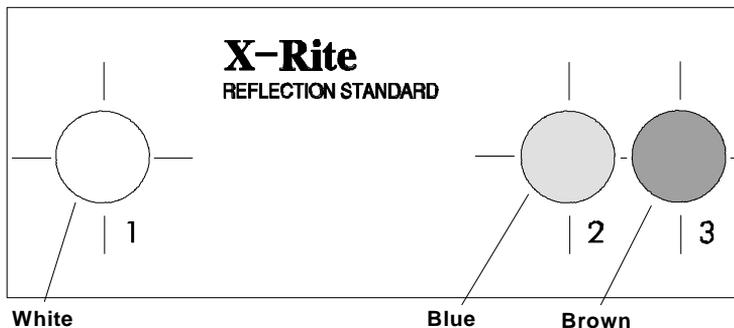
White   Blue   Brown

5) Record the L*a*b* values for each color on a piece of paper.

6) Repeat steps 1-5 for 10 days.

7) After 10 days average the white, blue, and brown values and enter data in the designated place on the color check label.

8) Enter date, illuminant, observer, aperture size, temperature, instrument model, and serial number on color check label. **Note:** Temperature of the reference standard should be maintained (±2°C) throughout color check sequence.

Periodic Color Check Procedure

1) Copy reference data located on the color check label to the shaded areas on the color check record located on the next page.

2) Perform steps 1-4 in reference data procedure.

3) Record the measured white, blue, and brown values and date on the color check record on the next page. **Note:** You may want to make several copies of the color check record before entering any data. This will allow you to have additional pages available when they are needed.

4) Compare measured values to the reference values.

   * If values are off, clean optics and reference standard and remeasure.
   * Consistent L*, a*, or b* differences exceeding .30 (or obvious trends away from the reference data) may require the unit to be serviced. Contact X-Rite or authorized service center if this is the case.
   * Always verify color performance with the same aperture size, illum/obs, and temperature.

COLOR CHECK RECORD

| Date: | Illuminant: | Observer: |
| Temperature: | Aperture Size: | Model-S/N: |

Reference Values / Date	White			Blue			Brown		
	L*	a*	b*	L*	a*	b*	L*	a*	b*