

X-Rite® MA48

Multi-Angle Spectrophotometer



Operator's Manual



Equipment Information

FCC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

Canada

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassent les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicte par le ministère des Communications du Canada.

AVERTISSEMENT : Des câbles d'interface blindés doivent être utilisés afin de se conformer aux règlements européens et FCC (USA) sur l'émission.

CE Declaration

Manufacturer's Name: X-Rite, Incorporated
Manufacturer's Address: 4300 44th Street, S.E.
Grand Rapids, Michigan 49512
U.S.A.

Model Name: Multi-Angle Spectrophotometer
Model No.: MA48

Directive(s) Conformance: EMC 89/336/EEC LVD 73/23/EEC

Warning:

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

WEEE

As of August 13, 2005, X-Rite products meet the European Union – Waste Electrical and Electronic Equipment (WEEE) directive. Please refer to www.xrite.com for more information on X-Rite's compliance with the WEEE directive.



Environmental Specifications

Operating Temp:	10° - 40°C
Relative Humidity:	0 - 85% non condensing
Usage:	Indoor Only
Altitude:	2000m
Pollution Degree:	2
Overvoltage:	Category II

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

Input Power Requirements

12/15Vdc, 700/560mA	
Use Only:	X-Rite No. SE30-81 (North America)
	X-Rite No. SE30-77 (International)

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Proprietary Notice

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

The contents of this manual are the property of X-Rite, Incorporated and are copyrighted. Any reproduction in whole or part is strictly prohibited. Publication of this information does not imply any rights to reproduce or use this manual for any purpose 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.

This instrument may be covered by one or more patents. Refer to the instrument for actual patent numbers.

Copyright © 2007 by X-Rite Incorporated

“ALL RIGHTS RESERVED”

Limited Warranty

X-Rite, Incorporated (“X-Rite”) warrants each instrument manufactured to be free of defects in material and workmanship (excluding battery pack) for a period of 12 months. This warranty shall be fulfilled by the repair or replacement, at the option of X-Rite, of any part or parts, free of charge including labor, F.O.B. its factory or authorized service center.

This warranty shall be voided by any repair, alteration, or modification, by persons other than employees of X-Rite, or those expressly authorized by X-Rite to perform repairs, and by any abuse, misuse, or neglect of the product, or by use not in accordance with X-Rite’s published instructions.

X-Rite reserves the right to make changes in design and /or improvements to its products without any obligation to include these changes in any products previously manufactured. Correction of defects by repair or replacement shall constitute fulfillment of all warranty obligations on the part of X-Rite.

THIS WARRANTY IS EXPLICITLY IN LIEU OF ANY OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. THIS WARRANTY OBLIGATION IS LIMITED TO REPAIR OR REPLACEMENT OF THE UNIT RETURNED TO X-RITE OR AN AUTHORIZED SERVICE CENTER FOR THAT PURPOSE.

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.

X-Rite® is a registered trademark of X-Rite, Incorporated
All other logos, product names, and trademarks mentioned are the property of their respective holders.

Setup and Overview

Unpacking and Inspection

After removing the instrument from the shipping carton, inspect for possible damage. If any damage occurred during shipping, immediately contact the transportation company. Do not proceed with installation until the carrier's agent has inspected the damage.

Your instrument 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, contact X-Rite (1-888-826-3042 or 1-616-803-2100) to have a replacement shipped to you.

Packaging Content

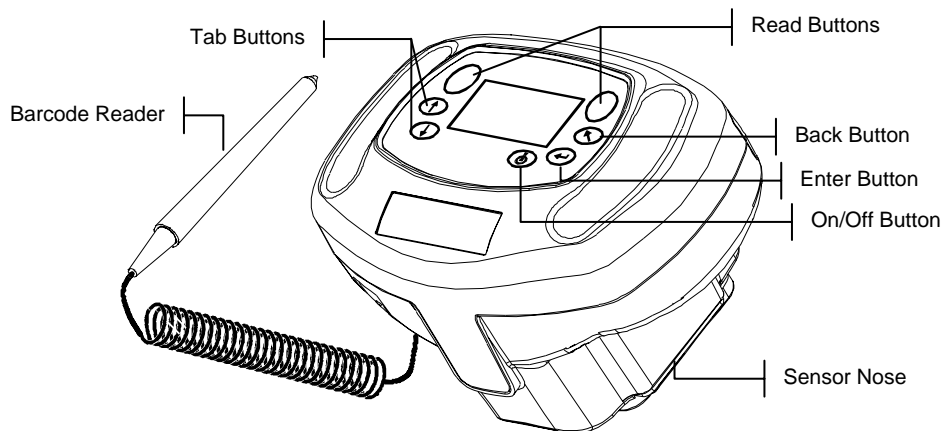
Your packaging should contain the all the items listed below. If any of these items are missing, contact X-Rite or an Authorized Representative.

- MA48 Instrument
- Docking Station
- Interface Cable
- AC Adapter
- White Calibration Reference
- Documentation and Registration Material

Instrument Description

The MA48 multi-angle spectrophotometer is designed for measuring color on metallic and pearlescent paint finishes. The instrument incorporates a single light source and five fixed—aspectual—viewing angles (15°, 25°, 45°, 75°, and 110°).

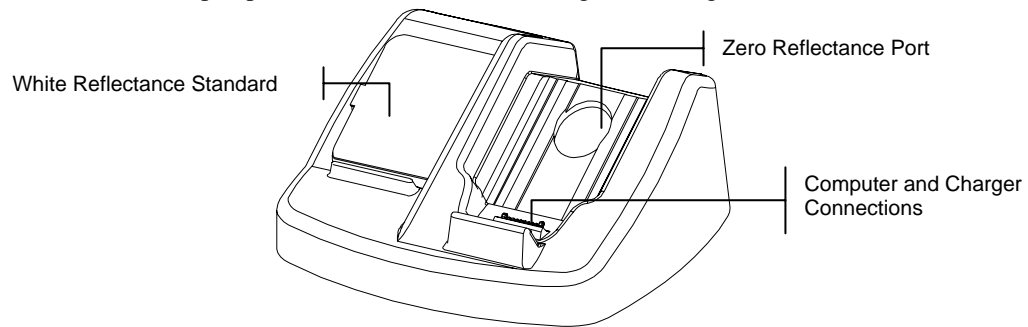
To ensure measurement accuracy, the MA48 also includes a two read-switch triggering mechanism. This allows a measurement to be taken only after the spectrophotometer has been properly positioned.



Docking Station Description

The docking station provides several important functions:

- storage of the instrument for nonuse times
- data transfer to the local computer (RS-232 or USB interface connection)
- charging of the instrument's internal battery (refer to section 3: Battery Refresh Operation)
- an open port for zero reflectance readings and storage for the white cal reference

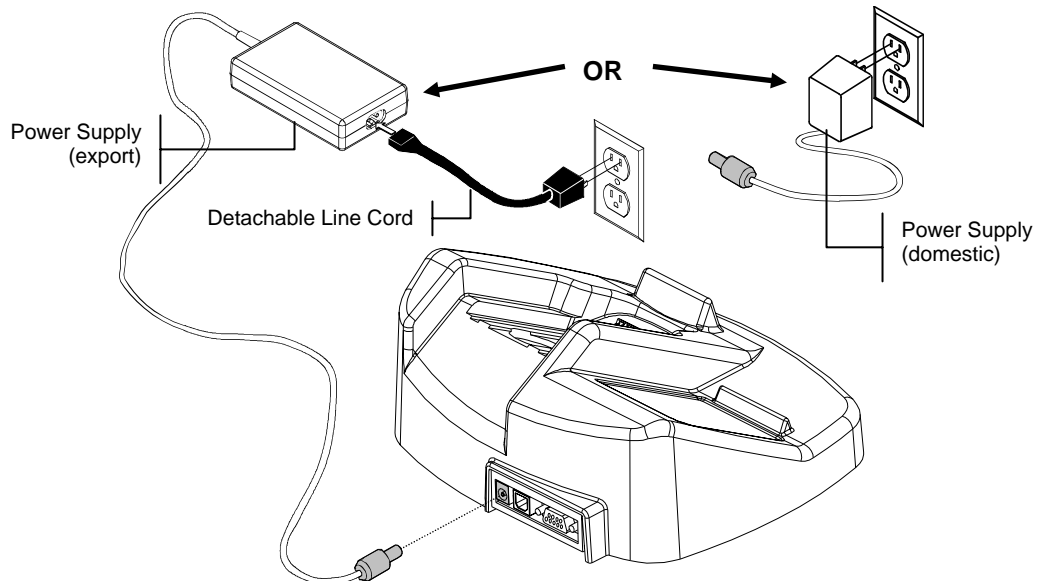


Setting Up the System



Use only X-Rite power supply P/N SE30-81 (manufacturer's P/N J06ADT-53) or P/N SE30-77 (manufacturer's P/N PSA30U-120).

1. Locate the docking station next to the computer.
2. Plug the small connector end of the power supply into the back of the docking station.
3. **Domestic Power Supply** - Plug the adapter into an AC wall receptacle.
Export Power Supply - Plug the detachable line cord into the power supply and then plug the line cord into an AC wall receptacle.



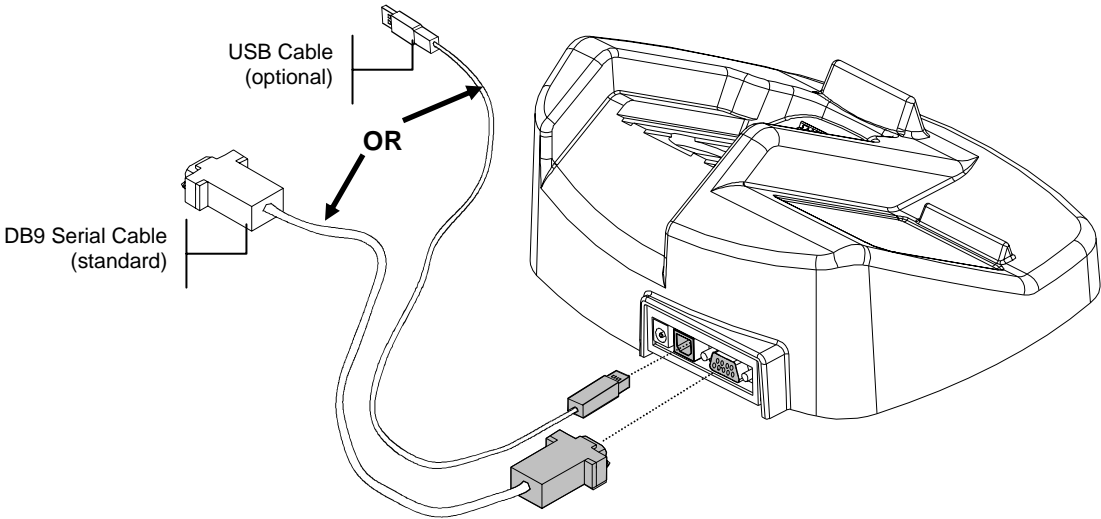
4. **DB9 Serial Interface (Standard)**
Connect the DB9 plug onto the 9-pin I/O port on the back of the instrument. Connect the other end into an available computer COM port.



USB Cable Interface (optional)

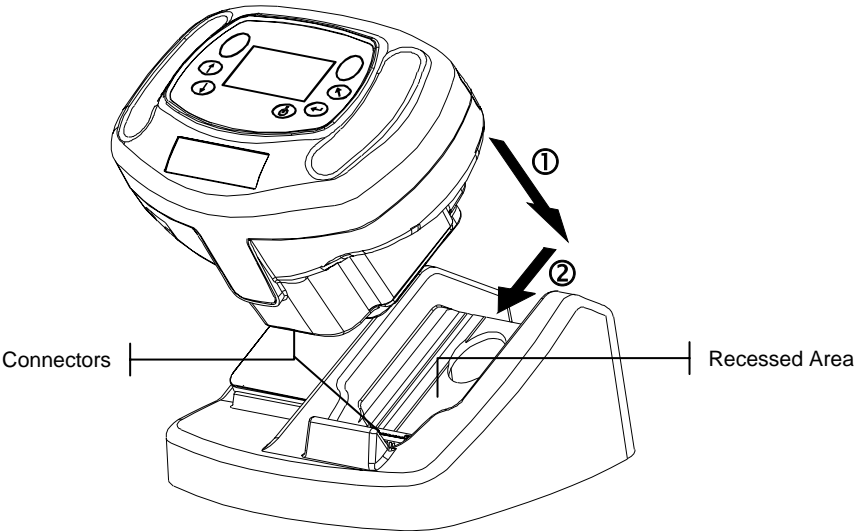
Plug the square end of the USB cable into the back of the docking station. Connect the other end of the USB cable to an available USB port on back of the computer.

After connecting the USB cable to your computer, a “Found New Hardware” message appears on the screen. You must install the USB driver for the instrument to communicate with your computer. Insert the Manuals and Utilities CD that came with your instrument into the CD drive and follow the instructions on the screen. The USB driver is located in the “Driver” folder on the CD.



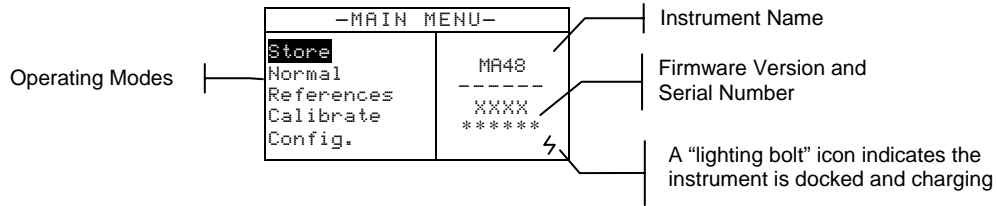
The instrument automatically goes into “charge mode” when it is placed on the docking station.

- 5. Place the instrument onto the powered docking station by positioning the sensor nose in the recessed area and sliding downward. Make sure the connector on the instrument is properly seated to the connector on the docking station. A “two-beep” conformation signal is heard and a “lighting bolt” icon appears in the lower right portion of the main screen when properly seated. The instrument must initially remain on the docking station for a minimum of four hours to allow the internal batteries to fully charge.



Main Screen Description

When the instrument is powered-up, the main (top level) screen appears. The main menu consists of two areas, Operating Modes and Instrument Data. The left side of the screen lists all available modes. The right side of the screen lists the instrument name, firmware version and serial number.



Button Operation

Perform reading and menu/option navigation with the six buttons arranged around the display screen. Each button has a unique symbol for performing a specific operation.



On/Off

Controls the instrument's power status when it is not in the docking station. As an added feature to conserve battery life, the instrument automatically powers down after five minutes of nonuse. The On/Off button must be used to turn on the instrument after an auto power down.



Tab Down

Advances the highlighted bar (reverse image) to the next available "tab stop." A tab stop indicates an item that can be acted on further, such as a measurement or an edit option. Tab stops generally follow a left-to-right or top-to-bottom sequence. When the last tab stop is reached, the next button press returns to the first tab stop in that menu's list. The button is also used to increment numeric values in the Reference mode.



Tab Up

Performs the same function as the Tab Down button except in reverse order. Tab stops follow a right-to-left or bottom-to-top sequence.



Enter

Used to activate/select the control chosen (highlighted) with the tab buttons. If the control can be set on or off, pressing the button toggles the option between on and off.



Back

Backs up the instrument screen one menu level. For example, if an option or value is being modified at the time the button is pressed, the edits are aborted and the previous screen or menu appears. The only exception to this is when the Enter button is used to toggle an option. In this case, the Back button exits the menu without aborting the setting.



Read

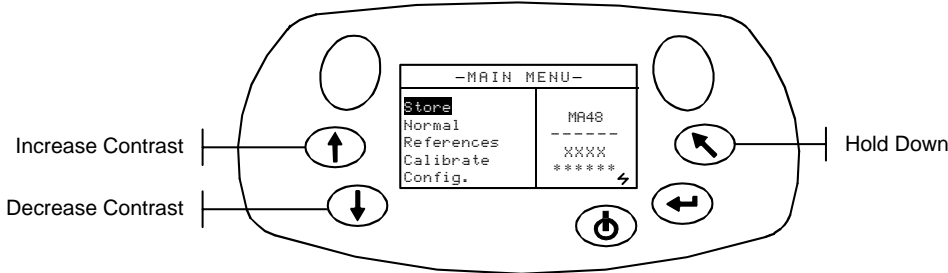
Initiates a reading when either Read button is pressed and both read switches are activated.



Adjusting Display Contrast

The contrast of the display can be adjusted for optimal viewing. Make sure the instrument screen is at the main menu before changing.

To adjust, hold down **Back** and press **Tab Up** to increase contrast or **Tab Down** to decrease contrast.



Optional Barcode Reader (BCR)

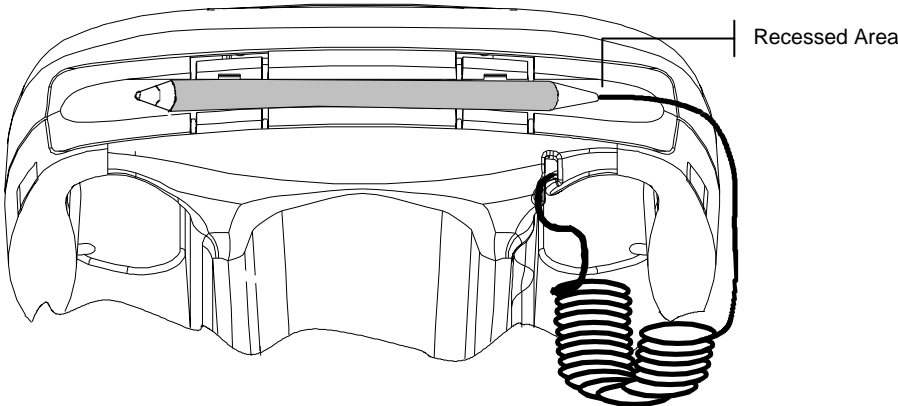


The barcode reader should only be used for its intended application (barcodes). Never look directly into the beam of light or direct the beam of light luminating at the tip of the reader in the direction of someone's eyes.

The instrument utilizes a barcode reader as a means of attaching tags to samples. Sample data that is uploaded from the instrument to the computer will include scanned tags. Refer to the end of Section Four for information on scanning tags in Store Mode.

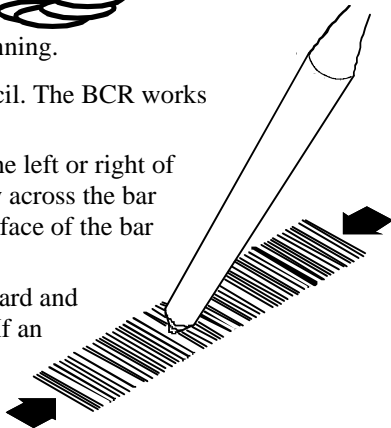
Using the Barcode Reader

The barcode reader is stored in a recessed area on the front edge of the instrument when not in use. Simply press it into the holder area to secure.



Follow these guidelines for successful bar code scanning.

1. Hold the BCR in your hand as you would a pencil. The BCR works best when slightly tilted.
2. Place the tip of the BCR on the white space to the left or right of the barcode. 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.
3. If the scan was successful, an audible beep is heard and the instrument displays the title of the barcode. If an audible beep is not heard, try scanning the barcode again.



Tab Down
 Tab Up
 Enter
 Back
 Read
 On/Off

Measurement Techniques

In order to obtain accurate and repeatable measurements, the bottom of the sensor nose must be flat with the surface to be measured. Any movement of the sensor nose can cause the measurement angles to vary, greatly affecting measurements on metallic paint finishes.

Measurements performed on a surface with a curve can cause the instrument to display a “Light Leakage” error. This is caused by stray light entering the measurement aperture.

A measurement takes place when both switches are activated on the bottom of the sensor nose. It may also be necessary to press one of the **Read** buttons to complete the measurement if the option is set in the Configuration mode. To achieve the best measurement repeatability, apply even pressure to both sides of the instrument during a measurement. The beginning and end of the measurement is signaled by audible beeps. Hold the instrument firmly until “**MEASUREMENT COMPLETE**” message is displayed.

Measurement Averaging

Measurement averaging is used to obtain an average value from various locations across a sample. The averaging option is activated in the Configuration mode and can be set from one to 99 measurements. All modes with the exception of Calibration use averaging when activated.

Measurement Sequence

1. Select mode of operation (Store, Normal or Reference).
2. Position instrument on first area of sample and take the measurement. The current measurement out of remaining measurements is displayed (e.g., 1 of 3).

NOTE: Averaging can be aborted at any time by pressing the **Back** button.

3. Position the instrument on the next area on the sample and take the measurement.
4. Continue with all required measurements.
5. After the last average measurement is taken, Averaging Complete appears on the screen and then the averaged data.



Instrument Calibration

General Information

Regular calibration of the instrument is important in maintaining accurate measurements. The instrument should be calibrated to the white standard and docking station (zero reference port) **the first thing each day, and every twelve hours of operation thereafter**. A **Cal Required** message appears in the display when the calibration procedure has not been performed for 12 hours.

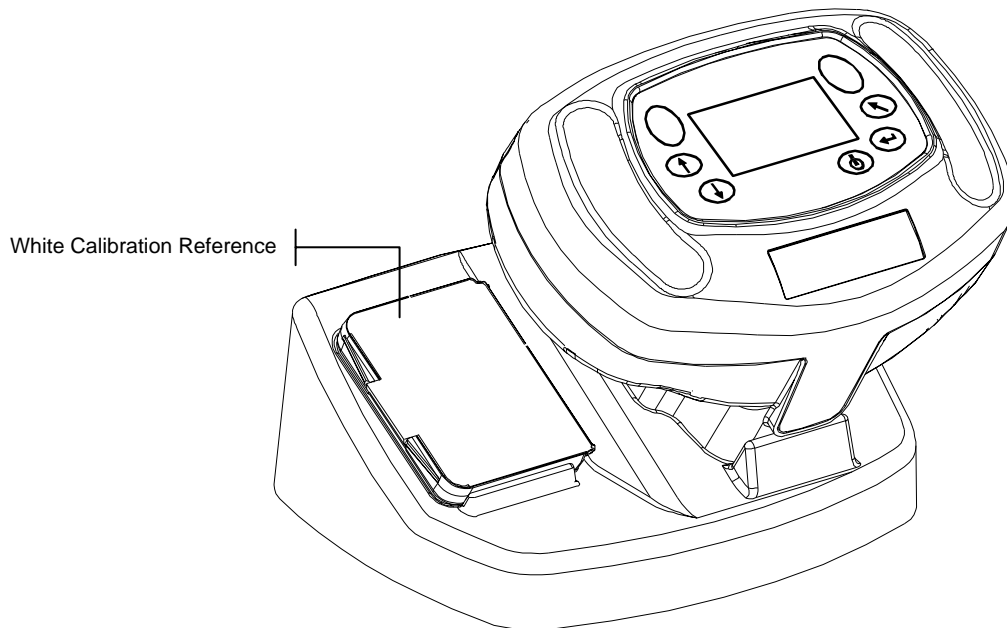
Whenever this message appears in the display, the calibration procedure must be performed. No measurements can be taken until calibration is completed.

Calibration Notes

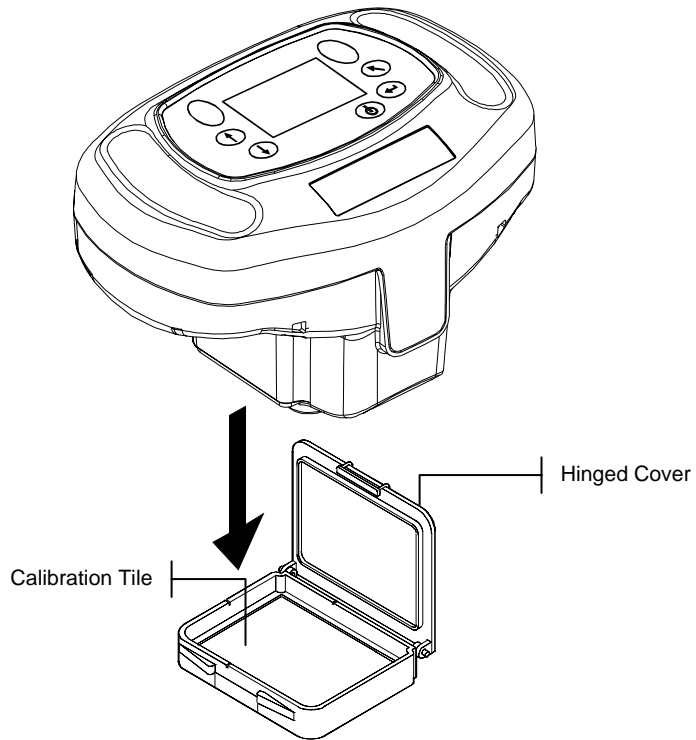
- Dirt or dust in the optics area will cause an inaccurate calibration reading. Refer to Section Four for optics cleaning procedure.
- The white calibration reference is dramatically affected by smudge marks, dust, and fingerprints. Refer to Section Five for white calibration cleaning procedure.
- Do not move instrument while taking calibration measurements. If motion is detected, an error message displays and the calibration is aborted.

White Calibration Reference

The white calibration reference is stored on the left side of the docking station and is designed to keep the reflection tile free of dust and debris.

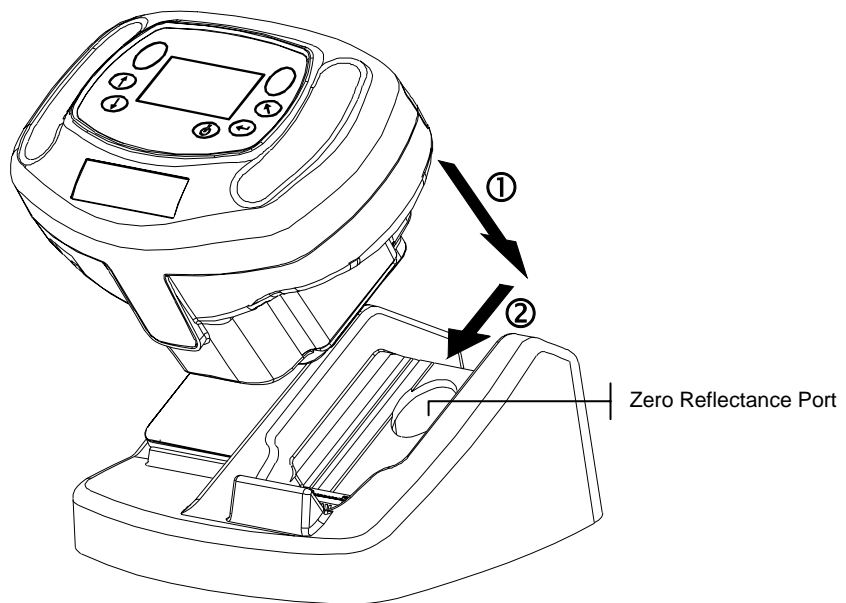


The white calibration reference tile is concealed in a case that has a hinged cover. Position the sensor nose of the instrument in the case and take the measurements. Make sure the calibration tile is positioned directly under the measurement aperture.



Zero Reflectance

The docking station is used to perform the zero reflectance measurement portion of the calibration procedure. Place the instrument in its normal position on the station and take the measurements over the cutout beneath the sensor nose.



Calibration Procedure

The calibration procedure consists of two white reference measurements followed by four zero reflectance measurements.

1. Use **Tab Down** or **Tab Up** to highlight Calibrate. Press **Enter** to access the calibration function.

-MAIN MENU-	
Store	MA48
Normal	-----
Reference	XXXX
Calibrate	*****
Config.	

The instrument displays the calibration status and reference serial number. The serial number displayed must match the number listed on the calibration reference. If the calibration status is OK, no calibration is required at this time. If Cal Required is the current status, you must perform the calibration procedure before continuing with any additional measurements.

Calibration
Measure White Ref Press Firmly
Status: Cal Required S/N: XXXXX

2. Remove the white calibration reference from the docking station and position the instrument on the reference as previously discussed. Hold the instrument down and momentarily press one of the **Read** buttons. Hold steady until the instrument indicates that both the white calibration readings are complete.
3. After successful white calibration readings, position the instrument in its normal position on the docking station. The display indicates that the Black Ref measurements are now required. Hold the instrument steady against the docking station and momentarily press one of the **Read** buttons to take the measurements. You must keep the instrument steady through all four measurements.

After the measurements are completed, the display automatically returns back to the main menu.



SECTION TWO

2-4

Tab Down



Tab Up



Enter



Back



Read



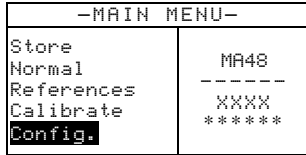
On/Off



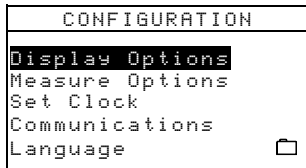
Setting Instrument Configuration

The Configuration mode consists of a several settings that can be edited to customize your instrument for your particular application.

1. Use **Tab Down** or **Tab Up** to highlight Config.



2. Press **Enter** to access the Configuration mode.



Display Options

The Display Options allows you to configure the following settings:

Active ΔE – Allows you to choose the Delta E method that is available in Store and Normal modes. Available settings are: $\Delta E^*a^*b^*$, ΔE_{cmc} , ΔE_{c6175} , ΔE_{p6175} and ΔE_{e6175} .

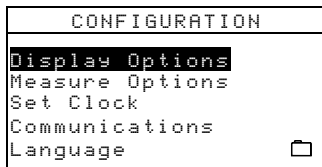
Active Illum/Obs – Allows you to select the illuminant/observer combinations available in Store and Normal mode. An arrow (>) indicates the illum/obs combination is active.

Active Angles – Allows you to select which three angles are displayed on the screen in Store mode and Reference mode. Available setting are: “15°/45°/75°”, “25°/45°/75°”, “25°/45°/110°”, and “15°/45°/110°.”*

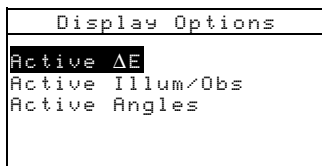
15°/45°/110° viewing geometry by license from E.I. DuPont de Nemours and Co., Inc. U.S. Patent No. 4,479,718.

Editing Display Options

1. Press **Tab Up** or **Tab Down** to move the highlight to Display Options.



2. Press **Enter** to access the Display Options menu.



Active ΔE

1. Press **Tab Up** or **Tab Down** to move the highlight to Active ΔE and press **Enter** to open the Active ΔE editor.
2. Press **Tab Up** or **Tab Down** to move the highlight to desired ΔE and press **Enter** to select setting and exit editor.



Active Illuminate/Observer

1. Press **Tab Up** or **Tab Down** to move the highlight to Active Illum/Obs and press **Enter** to open the Active Illum/Obs editor.
2. Press **Tab Up** or **Tab Down** to move the highlight to the desired 10° combination and press **Enter** to toggle the combination active or inactive. The arrow (>) indicates active.
3. To edit 2° combinations, highlight To 2° using **Tab Up** or **Tab Down** and press **Enter**.
4. Press **Tab Up** or **Tab Down** to move the highlight to the desired 2° combination and press **Enter** to toggle the combination active or inactive. The arrow (>) indicates active.
5. After edits are complete, press **Back** to save and exit the illum/obs editor.

Active Angles

1. Press **Tab Up** or **Tab Down** to move the highlight to Active Angles and press **Enter** to open the Active Angles editor.
2. Press **Tab Up** or **Tab Down** to move the highlight to Angle #1 and press **Enter** to toggle between 15° and 25°.
3. Press **Tab Up** or **Tab Down** to move the highlight to Angle #3 and press **Enter** to toggle between 75° and 110°.
4. After edits are complete, press **Back** to save and exit the editor.

Measure Options

The Measure option allows you to configure the following settings:

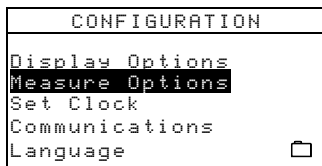
Auto Ref – Sets the automatic reference option. When Auto Reference is enabled (on), the stored reference that most closely matches the measured sample is automatically selected during a Store or Normal measurement. When Auto Reference is disabled (off), you must manually select a reference before taking a measurement.

Averaging – Sets the number of readings (0-99) required to obtain an averaged measurement.

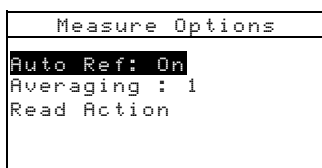
Read Action – Allows you to have the measurement activated by bottom switches (Foot Switches only), Read button (Read Key only), or in combination of the Read button and bottom switches (Switch & Key req.).

Editing Measure Options

1. Press **Tab Up** or **Tab Down** to move the highlight to Measure Options.



2. Press **Enter** to access the Measure Options editor.



Auto Reference

- Press **Tab Up** or **Tab Down** to move the highlight to Auto Ref and press **Enter** to toggle between Off and On.

Averaging

1. Press **Tab Up** or **Tab Down** to move the highlight to Averaging and press **Enter** to active the averaging # editor (up/down arrows appear to the left).
2. Press **Tab Down** to page backward through the averaging numbers, or press **Tab Up** to page forward through the numbers.
3. Press **Enter** to select the displayed averaging number.

NOTE: Use the Back button to revert back to the original setting.

Read Switches

1. Press **Tab Up** or **Tab Down** to move the highlight to Read Action and press **Enter** to open the read action editor.
2. Press **Tab Up** or **Tab Down** to move the highlight to Foot switches only, Read Key only, or Switch & Key req. and press **Enter** to save selection and exit.

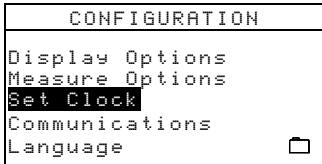
Exiting Measure Option

- After you have completed all the measure option editing, press **Back** to return to the Configuration menu.

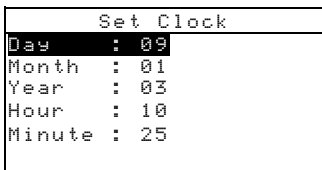
Set Clock

The Set Clock configuration is used to adjust the internal clock of the instrument.

1. Press **Tab Up** or **Tab Down** to move the highlight to Set Clock.



2. Press **Enter** to access the Set Clock editor.



3. Press **Tab Up** or **Tab Down** to move the highlight to Day, Month, Year, Hour or Minute and press **Enter** to activate the editor (up/down arrows appear to the left).
4. Press **Tab Down** to page backward through the digits, or press **Tab Up** to page forward through the digits.
5. Press **Enter** to select the displayed digit.

NOTE: Use the Back button to revert back to the original setting.

6. Continue with additional date/time edits as required.

Exiting Clock Set Option

- After you have completed all the clock editing, press **Back** to return to the Configuration menu.



Communications

The Communication option allows you to configure the following settings:

Baud Rate – Determines the data input/output rate of the instrument. The rate can be set at 9600 or 19200.

Automatic LF – Varies the delimiter at the end of each line of data. When set to LF On, a line feed is sent at the end of a line of data. When set to LF Off, no line feed is sent at the end of the line of data.

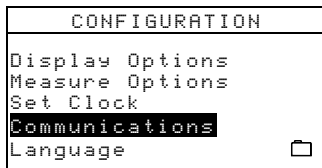
Data – Determines the type of data output from the instrument. When set to Color, color space data (L*a*b*, etc.) is output. When set to Spectral, spectral data in 10nm increments is output.

Header – Determines if the header information (L*a*b*, etc.) is output with measurement data. If set to Off, no header information is output. If set to On, header information is output.

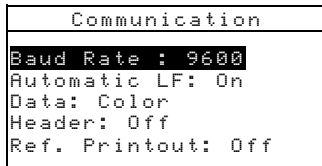
Ref. Printout – Determines if the reference data is output with measurement data. If set to Off, no reference data is output. If set to On, reference data is output.

Editing Communications Options

1. Press **Tab Up** or **Tab Down** to move the highlight to Communications.



2. Press **Enter** to access the Communications editor.



Baud Rate

- Press **Tab Up** or **Tab Down** to move the highlight to Baud Rate and press **Enter** to toggle between 9600 and 19200.

Auto Line Feed

- Press **Tab Up** or **Tab Down** to move the highlight to Automatic LF and press **Enter** to toggle between Off and On.

Data

- Press **Tab Up** or **Tab Down** to move the highlight to Data and press **Enter** to toggle between Color and Spectral.

Header

- Press **Tab Up** or **Tab Down** to move the highlight to Header and press **Enter** to toggle between Off and On.

Ref. Printout

- Press **Tab Up** or **Tab Down** to move the highlight to Ref. Printout and press **Enter** to toggle between Off and On.



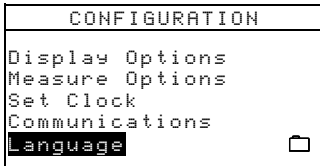
Exiting Communication Option

- After you have completed all the communications editing, press **Back** to return to the Configuration menu.

Languages

The Language configuration allows you to select the language you want to display on your instrument.

1. Press **Tab Up** or **Tab Down** to move the highlight to Language.



2. Press **Enter** to access the Language editor.



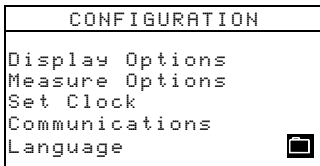
3. Press **Tab Up** or **Tab Down** to move the highlight to the desired language.
4. Press **Enter** to save the selected language. The instrument returns to the Configuration menu with the selected language active.

Battery Refresh Operation

Your instrument is powered by a Ni-metal hydride battery pack. Because the battery will start to charge every time the instrument is docked in the station, this can, overtime reduce the capacity of the battery. Refreshing is the process of allowing your instrument's battery to drain completely and then charging all cells in the battery to 100%. Refreshing the battery from time-to-time helps extend the duration of use and life of the battery.

The process for refreshing the battery takes approximately eight hours and should be performed once a month. As the instrument cannot be used during this operation and must remain in the docking station the entire time, it is suggested that this procedure be performed at the end of a workday to minimize disruption.

1. Place the instrument in the docking station.
2. Press **Tab Up** or **Tab Down** to move the highlight to the Battery icon and then press **Enter**.



3. You are asked if you are sure you would like to begin the refresh operation. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.

The instrument displays “Please Wait, battery maintenance in progress” during the discharge phase of the operation. This screen automatically disappears when the charging portion of the operation begins.

NOTE: To abort the refresh operation at anytime, simply power down the instrument and then power it back up.



SECTION THREE

3-6

Tab Down



Tab Up



Enter



Back



Read



On/Off



Instrument Operation

Reference Mode

The instrument can store a maximum of 100 references with tolerances which are accessible in the Store and Normal modes. The reference mode is used to measure references and edit their tolerances. References can also be downloaded from an X-Rite software application, such as X-RiteColor Master. If a reference is downloaded, it can be viewed but not edited.

1. Use **Tab Up** or **Tab Down** to highlight References.

-MAIN MENU-	
Store	MA48
Normal	-----
References	XXXX
Calibrate	*****
Config.	

2. Press **Enter** to access the reference mode.

Reference: 1	Current reference number
Tolerance: $\Delta L^*a^*b^*$	Tolerance type for selected reference
Edit Tolerances	Accesses tolerance editing menu
31.43 24.57 262.34	Angle data for current reference
30.50 24.45 262.14	
32.41 26.03 262.19	

Selecting a Reference Number and Measuring

The reference mode has a special control that is used to select a reference number. The list can be paged through either forward or backward to reduce time.

Reference number will be replaced with the reference name when downloaded from X-RiteColor Master software.

1. Use **Tab Up** or **Tab Down** to highlight Reference: ##.
2. Press **Enter** to activate the editor. Up/down arrows appear at the left.

Indicates the editor control is active	↕Reference: 1
	Tolerance: $\Delta L^*a^*b^*$
	Edit Tolerances
	31.43 24.57 262.34
	30.50 24.45 262.14
	32.41 26.03 262.19

3. Press **Tab Down** to page backward through the reference numbers, or press **Tab Up** to page forward through the list. To quickly page through the references, hold down one of the **Tab** keys.
4. Press **Enter** to select the displayed reference number.

NOTE: Use Back to revert back to the original reference.

5. Refer to section 1: Measurement Techniques for information on proper positioning. Position the instrument over the reference and take the measurement. The selected angles appear momentarily during the measurement.

NOTE: If the averaging option is activated in the Configuration mode, you must make additional measurements on the reference. Refer to section 1: Measurement Averaging for additional information.



Selecting the Tolerance Type and Editing Values

After selecting a reference number and measuring a reference, you can select a tolerance type and edit tolerance values. If a tolerance is not going to be used, select the NONE option. The tolerance type and values cannot be changed if the reference number is empty or if the reference was downloaded.

The attributes that are available for adjustment depend on the tolerance type selected.

- $\Delta E^*a^*b^*$, $\Delta Ec6175$, $\Delta Ep6175$ and $\Delta Ee6175$ tolerance types allows tolerance adjustment for each angle.
- ΔFI tolerance type allows high/low tolerance adjustment for the flop index.
- $\Delta L^*a^*b^*$ and ΔL^*C^*h tolerance types allows high/low tolerance adjustment for each angle.
- $\Delta Ecmc$ tolerance type allows a global adjustment for “l” (lightness factor) and “c” (chromaticity factor). The “cf” (commercial factor) can be adjusted for each angle).

1. Use the **Tab Up** or **Tab Down** to highlight Tolerance:.
2. Press **Enter** to page through the tolerance types: None, $\Delta L^*a^*b^*$, $\Delta L^*C^*H^*$, ΔFI , $\Delta E^*a^*b^*$, $\Delta Ecmc$, $\Delta Ec6175$, $\Delta Ep6175$ and $\Delta Ee6175$.

```
Reference: 1
Tolerance:  $\Delta L^*a^*b^*$ 
Edit Tolerances
31.43 24.57 262.34
30.50 24.45 262.14
32.41 26.03 262.19
```

3. After selecting the tolerance type, use **Tab Down** to highlight Edit Tolerances.

```
Reference: 1
Tolerance:  $\Delta L^*a^*b^*$ 
Edit Tolerances
31.43 24.57 262.34
30.50 24.45 262.14
32.41 26.03 262.19
```

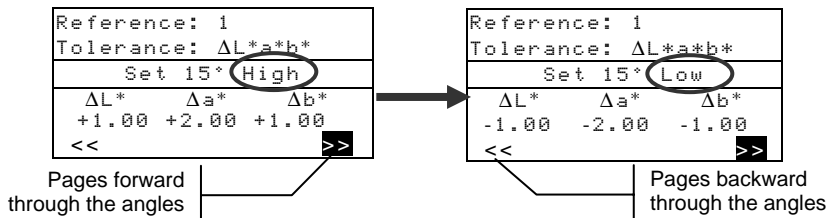
4. Press **Enter** to access the tolerance editing screen.

```
Reference: 1
Tolerance:  $\Delta L^*a^*b^*$ 
Set 15° High
 $\Delta L^*$   $\Delta a^*$   $\Delta b^*$ 
+1.00 +2.00 +1.00
<< >>
```

Selecting an Angle and High/Low Tolerance for Editing

The angles and high/low tolerances available for editing depends on the tolerance type selected. All angles and high/low tolerances for each tolerance type are selected using the same method.

1. Press **Tab Up** or **Tab Down** to move the highlight to the left double arrow (<<) or the right double arrow (>>).
2. Press **Enter** to page through the available angle and/or high/low tolerance screens.



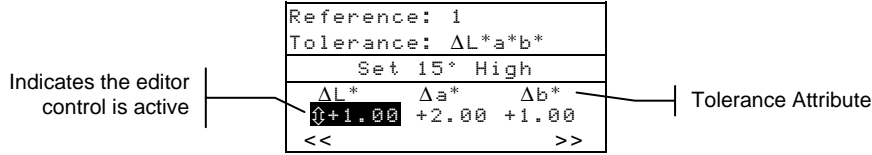
3. After selecting an angle tolerance, advance to Editing an Attribute Value.



Editing an Attribute Value

The attributes available for editing depend on the tolerance type selected. Values for all types are edited in the same manner.

1. Press **Tab Up** or **Tab Down** to move the highlight to a tolerance attribute.
2. Press **Enter** to activate the editor. Up/down arrows appear at the left.



3. Press **Tab Down** to decrease the value, or press **Tab Up** to increase the value.

NOTE: While the editor is activated (arrow control displayed), you can use **Back** to revert back to the original value.

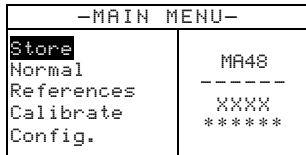
4. Press **Enter** to select the displayed value and close the editor control.
5. Press **Back** to exit the tolerance editing screen.

Store Mode

The store mode is used to store sample measurements in selectable group numbers. Measured samples are compared to stored references with or without tolerance values applied. If tolerance values are applied to the reference, pass/fail indication and difference data appears on the instrument for the three predefined angles. The instrument is capable of storing 800 samples across 20 groups.

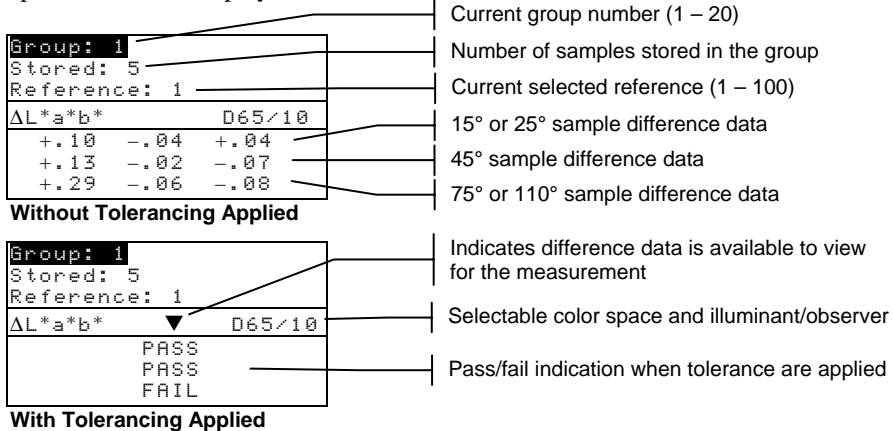
Store mode is also used to view and delete stored sample data, as well as output stored data to a printer or to a software application, such as X-RiteColor Master.

1. Use **Tab Up** or **Tab Down** to highlight Store.



2. Press **Enter** to access the store mode.

The information displayed depends upon whether tolerancing is used and if the color space selected is displayed as absolute or difference.

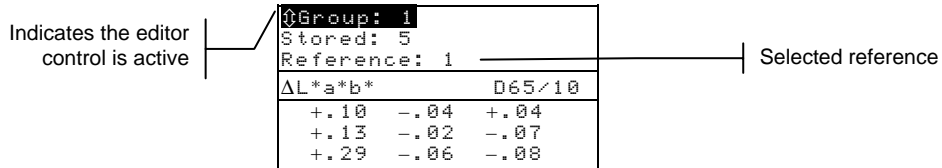


Selecting a Group/Reference and Measurement

Groups and references are selected in the same manner. If Auto Reference is activated in configuration, there is no need to select a reference before taking a measurement. The instrument automatically selects the closest match to the measured sample.

NOTE: A reference cannot be edited from within the Store mode. You must access the reference from the main menu screen.

1. Use **Tab Up** or **Tab Down** to highlight Group: ##.
2. Press **Enter** to activate the editor. Up/down arrows appear at the left.



3. Press **Tab Down** to page forward through the group numbers, or press **Tab Up** to page backward through the list. Twenty groups are available.
4. Press **Enter** to select the displayed group number.

NOTE: Use **Back** to revert back to the original group.

- If Auto Reference is not activated in Configuration, select the reference in the same manner as the group number.
 - If tags are to be stored with the sample, you can scan them in at this point using the optional BCR. Refer to Tagging Samples at the end of this section for information on tag options.
5. Position the instrument over the sample and take the measurement. You may have to press **Read** to complete the measurement if the instrument is configured to do so. The selected angles appear momentarily during the measurement and the stored sample number increments by one.

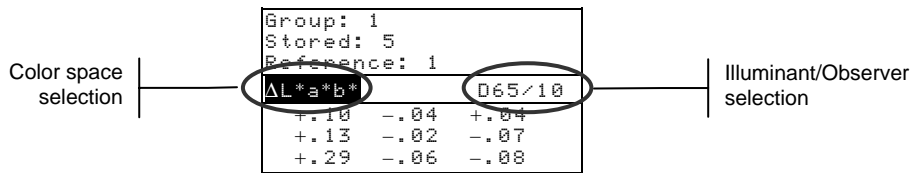
Measurement data is displayed as absolute or difference, or pass/fail indication if tolerancing is utilized. The instrument measures and stores five angles but only displays the three angles in Store mode. All five angles are output when data is transmitted.

NOTE: If the averaging option is activated in the Configuration mode, you must make additional measurements on the sample. Refer to section 1: Measurement Averaging for additional information.

Changing Color Space and Illuminant/Observer

Measurement angle data can be viewed under different color space and illuminant/observer conditions.

1. Use **Tab Up** or **Tab Down** to highlight Color Space (e.g. $\Delta L^*a^*b^*$ or Illum/Obs (e.g. D65/10).
2. Press **Enter** to page through the available color space or illuminate/observer options. Data is automatically updated to the selected option.



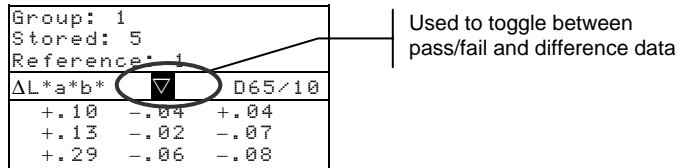
NOTE: Certain illuminant/observer combinations may not appear as you page through the list. Certain combinations may be deactivated in the configuration options. D65¹⁰, A¹⁰ and F2¹⁰ are the factory default combinations.



Switching Between Pass/Fail Indication and Difference Data

Difference data can be viewed for a pass/fail measurement. A down arrow icon (▼) appears between the selected color space and illuminate observer when tolerancing is set with a reference. A solid down arrow (▼) appears for pass/fail indication, and an open down arrow (▽) appears for difference data displayed. Pass/Fail indication always appears first after a measurement.

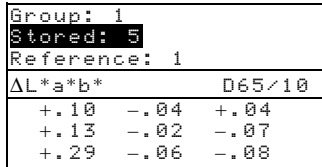
1. After a measurement, use **Tab Up** or **Tab Down** to highlight down arrow (▼).
2. Press **Enter** to toggle between pass/fail indication (solid down arrow ▼) and difference data (open down arrow ▽).



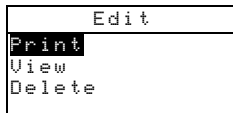
Edit Menu (Print, View and Delete)

Stored measurement data is accessible for outputting, viewing and deleting.

1. From within Store mode, use **Tab Up** or **Tab Down** to highlight Stored: ##.



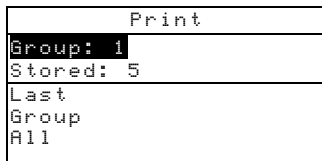
2. Press **Enter** to activate the Edit popup window.



3. Use **Tab Up** or **Tab Down** to highlight the Print, View or Delete option. An explanation of each option follows.

Print (output)

The print option allows you to output the last stored sample in a group or all samples in a group. All samples can also be output from all groups. Data that is transmitted is based on the Communication options set in the configuration menu.



Last Sample or Group Output

1. Press **Enter** with Group: # highlighted. This activates the editor.
2. Use **Tab Up** or **Tab Down** to select the desired group and then press **Enter**.
3. Use **Tab Up** or **Tab Down** to highlight Last or Group in the lower portion of the screen and press **Enter**.
4. You are asked if you are sure you want to print the last sample. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.



All Output

1. Use **Tab Up** or **Tab Down** to highlight All in the lower portion of the screen and press **Enter**.
2. You are asked if you are sure you want to print all the samples. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.

View

The view option allows you to retrieve and view a stored sample from a selected group. The selected sample can also be deleted from this screen. Absolute data is displayed in the View menu with the current color space and illum/obs selections applied.

View		
Group: 1		
Sample: 5 of 5		
Delete		
30.99	-3.26	-24.41
30.13	-3.18	-24.19
31.99	-2.87	-24.63

View Sample Data

1. Press **Enter** with Group: # highlighted. This activates the editor.
2. Use **Tab Up** or **Tab Down** to select the desired group and then press **Enter**.
3. Use **Tab Up** or **Tab Down** to select Sample: # of # and press **Enter**. This activates the editor.
4. Use **Tab Up** or **Tab Down** to select the sample and then press **Enter**. The selected sample data is now displayed.

Deleting Selected Sample

1. Use **Tab Up** or **Tab Down** to highlight Delete and then press **Enter**.
2. You are asked if you are sure you want to delete the displayed sample. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.

Delete

The Delete option works identical to the Print option. The last stored sample in a group or a specific group's samples can be deleted. All stored samples can also be selected for deletion.

Delete	
Group: 1	
Stored: 5	
Last	
Group	
All	

Last Sample or Group Delete

1. Press **Enter** with Group: # highlighted. This activates the editor.
2. Use **Tab Up** or **Tab Down** to select the desired group and then press **Enter**.
3. Use **Tab Up** or **Tab Down** to highlight Last or Group in the lower portion of the screen and press **Enter**.
4. You are asked if you are sure you want to delete the last sample. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.

All Delete

1. Use **Tab Up** or **Tab Down** to highlight All in the lower portion of the screen and press **Enter**.



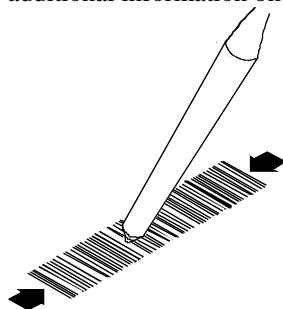
2. You are asked if you are sure you want to delete all the stored samples. Press **Tab Up** or **Tab Down** to move the highlight to Yes and press **Enter**.

Tagging Samples (using the optional BCR)

Barcodes are scanned as “tags” and stored with sample measurements. Sample data that is output includes the attached tags (up to six tags per sample). There are three tagging options that become available once a barcode is scanned.

- **Next Sample Tag** option stores the scanned tag with the next sample measured.
- **Current Group Tag** option stores the scanned tag with every measurement saved to a selected group. The first tag scanned in a group is also used as the group name.
- **All Tag** option stores the scanned tag with all measurements taken in Store mode.

1. Make sure the instrument is in Store mode and select the Group number as previously explained.
2. Using the instrument’s optional BCR, scan the tag barcode. Refer to Section One for additional information on use of the optional barcode reader.



The name of the barcode appears on the second line of the display. If the name does not appear on the instrument display, refer to Troubleshooting Tips in Section Five.

Barcode Read
Sample #1234
To be stored as an All Tag
SAVE

3. With Tag Option highlighted, press **Enter** to page though a **current Group Tag**, the **Next Sample Tag** and an **All Tag**.

NOTE: The “All Tag” option will not appear if any samples are stored in the instrument, and “Group Tag” option will not appear if any measurements are stored in the selected group.

4. Use **Tab Up** or **Tab Down** to select SAVE and then press **Enter**.
5. If additional tags (up to six) are required for the following sample(s), scan in with the BCR and repeat step 3 and 4.
6. After tagging, position the instrument over the sample and take the measurement. You may have to press **Read** to complete the measurement if the instrument is configured to do so.



Normal Mode

The Normal mode provides the same measurement and viewing options as Store mode without storing any data. Measured samples can be compared to stored references with or without tolerance values applied. If tolerance values are applied to the reference, pass/fail indication appears on the instrument. Sample data can also be viewed under various color space and illuminant/observer combination. Normal mode displays absolute/difference data and pass/fail indication for all five angles.

1. Use **Tab Up** or **Tab Down** to highlight Normal.

-MAIN MENU-	
Store	MA48
Normal	-----
References	XXXX
Calibrate	*****
Config.	

2. Press **Enter** to access the Normal mode.
The information displayed depends upon whether tolerancing is used and which color space (absolute or difference) is selected.

Reference: 1	
L*a*b*	D65/10
29.67	-3.92 -23.67
29.72	-3.66 -23.99
30.08	-3.68 -24.69
32.94	-3.24 -25.59
29.67	-3.92 -23.67

Without Tolerancing Applied

Reference: 1	
L*a*b*	▼ D65/10
	PASS
	PASS
	FAIL
	PASS
	PASS

With Tolerancing Applied

3. If you want to compare stored reference data to measured samples, and Auto Reference is not activated in the Configuration, you must manually select a reference. Press **Enter** to activate the editor. Up/down arrows appear at the left. Press **Tab Down** to page forward through the reference numbers, or press **Tab Up** to page backward through the list. Press **Enter** to select the displayed reference number.
4. Position the instrument over the sample and take the measurement. You may have to press **Read** to complete the measurement if the instrument is configured to do so.
5. Use **Tab Up** or **Tab Down** to highlight color space (e.g. $\Delta L^*a^*b^*$) or illum/obs (e.g. D65/10).
6. Press **Enter** to page through the available color space or illuminate/observer options. Data is automatically updated to the selected option.



Service and General Maintenance

Repair Information

The instrument is covered by a one-year limited warranty—excluding battery pack and barcode reader—and should be referred to factory or authorized service center for repairs 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 repairs should be referred to the factory or an authorized service center (call 1-888-826-3042 or 1-616-803-2100).

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

Cleaning the Instrument and Docking Station

Whenever required, the exterior of the instrument and docking station may be wiped clean with a cloth dampened in water or a mild cleaner.

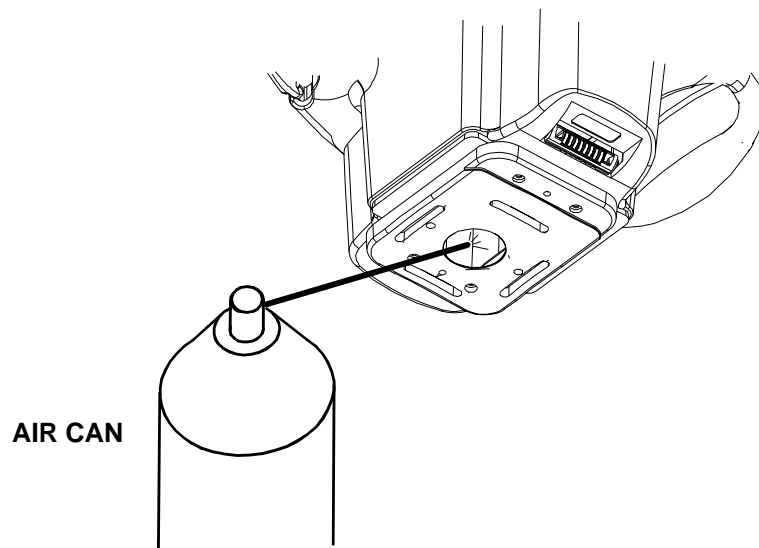


DO NOT use any solvents to clean the instrument or docking station; this will cause damage to the covers.

Cleaning the Optics

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

Carefully lift the instrument and blow shorts bursts of clean, dry air into the measurement aperture. This should remove any accumulated dust in the optics area.



Battery Replacement Information

If battery replacement is ever needed, a qualified repair technician or an authorized service center should perform the replacement. A battery replacement kit can be obtained by contacting an authorized service center.

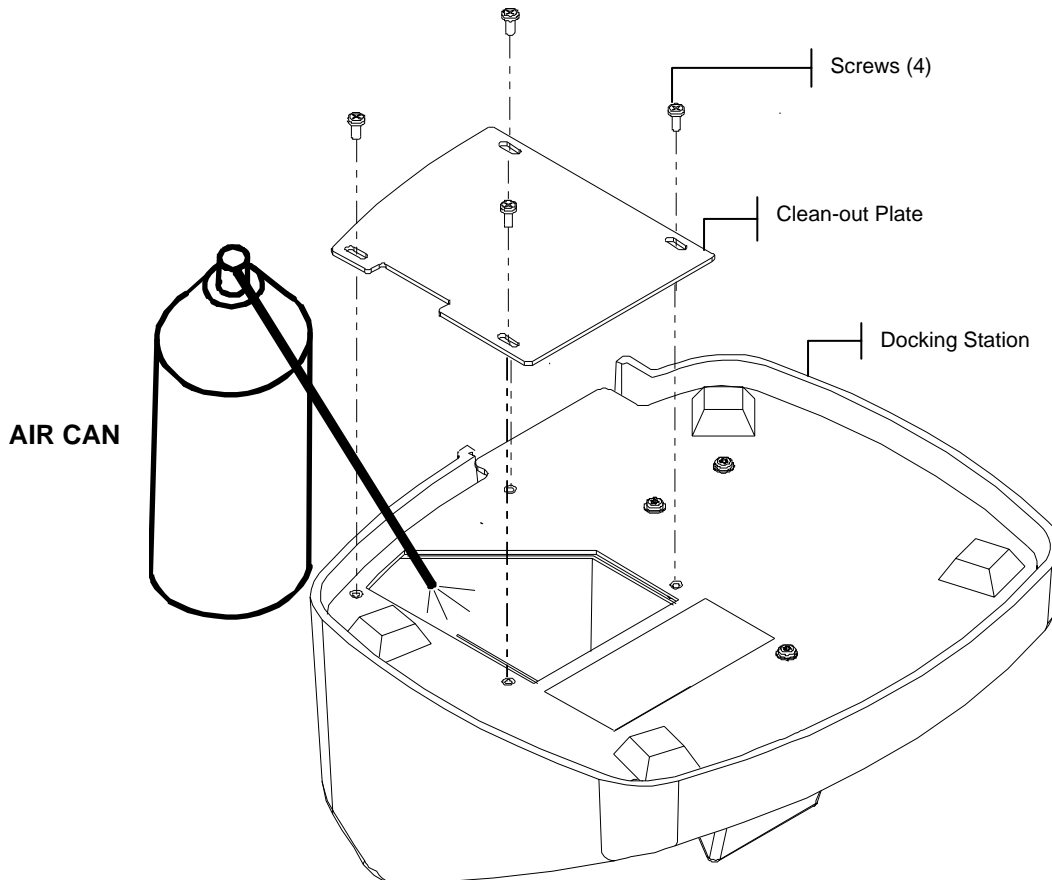
Cleaning the Calibration Reference

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. You must let the standard dry completely before taking a calibration reading.

Cleaning the Zero Reflectance Trap

The zero reflectance trap should be cleaned from time to time to remove any dust or contamination.

1. Unplug the interface cable and AC adapter from the docking station.
2. Remove the instrument from the docking station and turn the docking station over.
3. Remove the four screws that hold the clean-out plate in place and then remove the clean-out plate.
4. Blow shorts bursts of clean, dry air into the zero reflectance trap. This should remove any accumulated dust or contamination.
5. Reinstall the clean-out plate with four screws and connect the interface cable and AC adapter.



Troubleshooting Tips

Problem	Cause	Solution
The instrument display is hard to read.	Screen contrast set incorrectly.	Adjust the contrast as explained in Section One.
The instrument's battery pack will not charge.	AC adapter is not attached.	Check the connection on the back of the docking station and at the AC adapter.
	Internal battery pack is bad.	Contact an authorized service center.
Measurements not uploading to computer when the instrument is seating in the docking station.	Instrument is not properly seated in the docking station.	Make sure instrument is properly seated over the contacts.
	The interface cable is not attached.	Check the connection on the back of the docking station and at the computer.
	Contaminated connectors.	Disconnect docking station from computer and wall outlet. Clean connectors on the instrument and the docking station with a cotton swab dampened with Isopropyl alcohol. Cotton swab should not be saturated.
Instrument will not calibrate correctly.	Calibration reference is dirty.	Clean the calibration reference as specified in section 5.
	Optics is dirty.	Clean the optics as specified in section 5.
The instrument screen does not display anything.	Instrument is in power down mode.	Press the Power button to active the instrument.
	Screen contrast is set too low.	Adjust the contrast as explained in Section One.
	Internal batteries require charging.	Place instrument on docking station and charge battery pack for a minimum of 4 hours before use.
The optional barcode reader does not work.	Instrument is seating in the docking station.	Remove the instrument from the docking station. Barcode reader is disabled in the docking station.

Error Messages

Below is a list of typical error messages that could appear on your instrument display. If an error message should appear, make a note of it and take the appropriate steps to try to correct it. If an error message is consistently displayed, contact an authorized service center.

Reading Error Messages

Read Error – Batteries are weak. Please charge them. Indicates batteries are too low to operate the unit. Place the instrument in the docking station and allow the batteries to charge before attempting to take measurements.

Read Error – Light leakage has occurred. Stray light is getting into measurement aperture. Make sure measurement surface is flat.

Read Error – Max reflectance has exceeded. Surface measured is greater than the maximum range of the instrument.

Read Error – The motor has missed sync. - Instrument could not establish motor position. Measure again.

Read Error – Reset during read. Please check batteries. This message may appear if the instrument is stored for an extended period of time. Recharge the batteries for 4 hours.

Read Error – Read switch was released too soon. Both read switches were not closed during entire reading. Try taking the reading again.

Read Error – Lamp failure! Lamp must be replaced. The lamp intensity is too weak for accurate measurements. The lamp should only be replaced by an authorized service center.

Calibration Error Messages

Cal Failed = #### Calibration requires that the instrument remain motionless during the white calibration reading. 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.

Cal Failed – Max zero reflectance has been exceeded. Zero reflectance measurement was taken on something other than the zero reflectance port (docking station); or optics and/or zero reflectance trap require cleaning.

Cal Required – Due to user abort. The user aborted the calibration procedure during measurement sequence.

Cal Required – Due to bad zero cal. Zero reflectance calibration measurement was not properly updated.

Cal Required – Due to temperature. A 10°C change in temperature occurred since the last calibration.

Miscellaneous Error Messages

Warning – Batteries are weak. Please charge them. Indicates that the batteries are getting low and must be charged soon. The message will be displayed only while the measurement is in progress. The instrument will still take accurate measurements.

Warning – Lamp is getting weak. Replace soon. The lamp is marginal and should be replaced as soon as is conveniently possible.

Specifications

Measuring Geometrics

- 45° illumination
- 15°, 25°, 45°, 75°, 110° aspecular viewing
- Angular accuracy $\pm 0.15^\circ$
- Fiber optic pick-up, coupled with DRS technology

Measuring Area

- 0.5 in. diameter (12mm)

Light Source

- Gas-filled tungsten lamp, color corrected to approx. 4000°K

Illuminant Types

- C, D₆₅, D₅₀, A, F2, F7, F11 & F12

Standard Observers

- 2° and 10°

Receivers

- Blue-enhanced silicon photodiodes

Spectral Range

- 400nm – 700nm

Spectral Interval

28 band spectral measurement:

- 10nm interval from 400nm – 640nm
- 20nm interval from 640nm – 700nm
- 15nm bandwidths

Spectral Data Output

- Spectral reflectance values are available for output from the RS-232 or USB port via the docking station for 5 angles at 10nm intervals from 400nm – 700nm

Measurement Range

- 0 to 400% reflectance

Measurement Time

- Approx. 2.0 seconds

Inter-Instrument Agreement

- 0.20 ΔE^* avg. on reference BCRA tile set
- 0.40 ΔE^* max. on any chromatic tile
- 0.15 ΔE^* max. on any grey tile

Short-Term Repeatability

- 0.10 ΔE^*_{ab} on white ceramic

Lamp Life

- Approx. 500,000 measurements

Power Supply

- Built-in, rechargeable Ni-metal hydride battery pack; 7.2 VDC rated @ 1400 mAh

AC Adapter Requirements

- MA48: 90-130VAC, 50-60Hz, 15W max
- MA48X: 90-240VAC, 50-60Hz, 30W max

Charge Time

- In Instrument – 4 hrs

Measurements Per Charge

- 1,000 5-angle measurements (continuous measurements @ 10 sec. intervals)

Data Storage (Five Angles)

- 200 Standards
- 850 Samples

Data Interface

- Patented bi-directional RS-232 and USB, 9,600-19,200 baud

Display

- 128 x 256 pixel graphical LCD

Operating Temperature Range

- 50° to 104°F (10° to 40°C)
- 85% Relative humidity max (non-condensing)

Storage Temperature Range

- -4° to 122°F (-20° to 50°C)

Weight

- 2 lbs. 7 oz. (1.1 kg)

Dimensions

- 5.27" H (13.4cm) x 5.40" W (13.7cm) x 8.05" L (20.4cm)

Accessories Provided

- Calibration standards, docking station, AC Adapter, operators manual, and wrist strap

X-Rite standards are traceable to NIST (National Institute of Standards and Technology, USA) Calibration report (MCSL-18).
Product design and specifications subject to change without notice.



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