Model 404
Color Reflection Densitometer

Operation Manual

X-Rite
Dear Customer:

Congratulations! We at X-Rite, Incorporated are proud to present you with the X-Rite 404 Color Reflection Densitometer. This instrument represents the very latest in microcontrollers, integrated circuits, optics, and display technology. Your X-Rite 404 is a rugged, reliable, finely engineered instrument whose performance is unsurpassed.

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 404 with a full 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 Chief Executive Officer
FEDERAL COMMUNICATIONS COMMISSION NOTICE

FCC Statement
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.

Canada
This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.
**CAUTION:** Operational hazard exists if AC adapter other than X-Rite SE30-61 (115V) or SE30-62 (230V) is used.

**VORSICHT:** Es besteht Betriebsgefahr bei der Verwendung von einem Adapter außer X-Rite SE30-61 (115 U) oder SE30-62 (230 U).

**AVISO:** No use otro adaptador C.A. que no sea la pieza X-Rite SE30-61 (115V) o SE30-62 (230V), por el riesgo de mal funcionamiento del equipo.

**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.

**AVVISO:** Non usare un altro adattatore C.A. che non è del pezzo X-Rite SE30-61 (115V) o SE30-62 (230V), per il rischio di malfunzionamento dell’apparecchio.

**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.

**USE ONLY:** AA NICad batteries that are 600/700mAhr rated, six required. Other types may burst causing personal injury.

**AUFGEPASST:** Verwenden Sie nur AA Nicad Akkus von 600/700mAhr (Milliampere/Stunde) Nennstrom (6 Stück erforderlich). Mit anderen Akkus läuft die Gefahr von Explosion und Verletzung.

**ATENCION:** Use solamente las pilas de AA NiCad (se requiere seis) con condiciones de funcionamiento normales 600/700mAhr (horas milliamperios). Es posible que los otros tipos puedan estallar y causar daños corporales.

**ATTENTION:** Utiliser seulement les batteries NICad à courant nominal de 600mAhr (milliampre/heure) (6 pièces nécessaire). Il y a danger d'explosion et de blessures avec les autres types.

**ATTENZIONE:** Usare solamente gli accumulatori al AA NiCad (si richiede sei) con le condizioni di funzionamento normali 600/700mAhr (ore milliamperi). E possibile che altri tipi possano scoppiare e causare danno personale.
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X-Rite is a registered trademark and Quick Cal™, Q Cal™, Computerized Color Response™, and CCR™, are trademarks of X-Rite, Incorporated. All other logos, brand names, and product names are the properties of their respective holders.
The X-Rite 404 Color Reflection Densitometer is designed to meet the quality control needs of today’s pressroom and graphic arts technicians. This completely portable instrument features different measurement modes for quickly measuring ink density and density difference. Measurements are taken with simple hand-held operation, and measurement data is clearly read on the interactive display. The three control buttons make operation easy.

**FEATURES**

The X-Rite 404 features several state-of-the-art technologies that place the instrument a step above competitive instruments in terms of accuracy, speed, and simplicity:

**Computerized Color Response™ (CCR)**
The versatile 404 accommodates multiple status responses. Model 404G can take measurements using ANSI-Status T response, which is compatible with the GCA T-reference (T-Ref) standard. You can also select the traditional X-Rite graphic arts response, Status G. Model 404E features European Status E and Status I (displayed as N) responses. Model 404A features Status A response used for Photo Finishing applications.

**QuickCal™ One-Step Calibration**
The 404’s Quick-Cal feature makes calibration fast and easy. You simply select the “Q-Cal” mode on the instrument, then measure the white patch on the supplied calibration target card. You can also get complete agreement with other densitometers using the three-color response calibration.
Automatic On/Shut-Off
To increase battery life, the 404 automatically turns itself off if it has not used within 45 seconds; and it automatically turns back whenever a key is pressed or measurement taken. Tests have shown that over 4,500 readings can be taken on one charge of new batteries.

Nonvolatile Memory
A lithium battery stores calibration data and measured values when the densitometer’s primary rechargeable batteries are depleted or removed.

Automatic Color Selection
Equipped with Auto Color Select, the 404 eliminates manual rotation of a filter wheel and related erroneous measurements. All colors are measured simultaneously, then the correct reading is displayed in less than one second.

Additional Features
- Large LCD display clearly identifies measurement data.
- Three large buttons place all function controls at operator’s fingertips.
- Small 1.7mm aperture (GS or ES model) for reading reduced-size color bar patches.
- AC adapter is provided to allow readings while batteries are being recharged.
- Replaceable optics allow you to switch between “A”, “G”, and “E” response.
- Two-way RS-232 interface operates at 1200 baud, or one of several other baud rates.
PACKAGING AND PARTS

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 to ensure that all items are included (refer to the parts list below).

Your Package Should Include...
1  404 Color Reflection Densitometer
1  Carrying Case
1  Operation Manual
1  Reflection Calibration Reference; 418-62 for Model 404, 418/LP-62 for Model 404/LP, or 302-12 for Model 404A
1  Warranty Registration Card
1  P/N SE30-61 Battery Charger, 115V
   or P/N SE30-62 Battery Charger, 230V
1  P/N SD01-41 Certificate of Calibration

Along with this Operation Manual, several important notices are included. You should read each of these notices before using the instrument.

Return Packaging
Your X-Rite 404 was packaged in a carton specially designed to prevent damage. If re-shipment is necessary, the instrument should be re-packaged in the original carton. If the original carton is not available, a new one can be obtained from X-Rite.
INSTRUMENT VOCABULARY

- 8-character Interactive Display
- 3 Operating Keys
- AC Adapter (Charger) Jack
- RS232 I/O Port
- Target Window
- Shoe

COLOR (▲) Button
COLOR (▼) Button
ZERO (▲▼) Button

Arrows indicate button’s function for adjusting display values up or down.
UNLOCKING/LOCKING THE SHOE

To take measurements with the instrument, you must unlock the Shoe (see Instrument Vocabulary drawing in previous chapter). When the instrument is not in use, the Shoe should be re-locked to protect the instrument optics.

A sliding button on the bottom of the instrument locks the Shoe closed.

To unlock, hold Shoe against the unit and slide the lock button back until the button latch clears the Shoe tab. Carefully release the Shoe to open. (Figure 1-1)

To lock, hold the Shoe against the unit and slide the lock button forward until the button latch captures the Shoe tab. (Figure 1-2)
BATTERIES AND POWER

Your 404 instrument’s batteries should be charged before use. It can be operated while the batteries are being charged.

Before you begin charging, you must remove the battery isolation insert protruding from the battery cover. (Figure 1-3)

NOTE: Make sure the voltage indicated on the AC adapter complies with the AC line voltage in your area. If it does not, contact your X-Rite dealer.

To charge the battery:

1. Plug the AC Adapter Line Cord into the AC Adapter Jack on back of instrument. (Figure 1-4)

2. Plug AC Adapter into AC wall outlet.

You can use the instrument while it recharges. The instrument will be fully charged in approximately 14 hours.
NOTE: If your unit has not been used for several weeks recharge for approximately 24 hours.

NOTE: When storing the unit for a long period of time, the batteries should be removed.

Applying Power
The instrument remains “powered down” until a measurement is taken. When a measurement is taken, or when any key is pressed, the instrument automatically turns on.

If no measurements are taken or keys pressed for 45 seconds, the instrument automatically turns off again to conserve battery power.

Inserting/Removing the Batteries
Your instrument is shipped with six AA NICAD batteries already installed. Should you ever need to replace the batteries, first close and lock the Shoe (when the shoe is unlocked and open, it blocks the battery door). Next, slide the battery door in the rear of the instrument down and off. The batteries will spring out a bit.

To replace the batteries, insert six fresh AA NICAD batteries into the instrument, three into each chamber. Note the proper polarity of the batteries in Figure 1-5, and on the CAUTION label beneath the instrument. You will need to press and hold the batteries down in place while you slide the battery cover back on. Push the cover into place until it is flush with the bottom of the instrument.

Figure 1-5
ADJUSTING THE DISPLAY ANGLE

You can most clearly read the LCD display by viewing it at a 90° angle. The angle of the display can be adjusted to accommodate this for different user sight lines.

To adjust the display angle:

1. Set the Display Angle Adjustment Knob on the right side of the instrument to its midpoint setting. (Figure 1-6)

2. Activate the display by taking a measurement or pressing a control button.

3. Adjust the Display Angle Adjustment Knob until the displayed data can be most clearly seen from your line of sight.

Figure 1-6
I/O PORT SETUP

Your X-Rite 404 has a serial port that allows data to be transmitted to—or received from—an external device. With this I/O connection made, the 404 can controlled externally by Serial Input Commands.

If you do not plan to use the I/O port at this time, you can skip ahead to Chapter 2, “Calibration.”

Depending on your instrument type, you can configure different functions for your I/O port using the instrument’s MODE selection procedures.

404G and 404E Units Only
• Computer output format (COMP) allow you to transmit a space after a each group of data values.

To set up the I/O port:
1. Press the ▼ button and the COLOR button simultaneously, then release.

   N cal T Y appears in the display, where “T” represents Status response (T, G, E, or N).

   N c a l T Y

2. Press ▼ to indicate no, you do not want to calibrate.

   N mode Y appears in the display.

   N m o d e Y

3. Press ZERO to indicate yes, you do want to set mode. RESP T appears in the display. Response selection will be covered in Section Three.

   ^ R e s p T

4. Press ▼ once. COMP ON or COMP OFF appears in the display.

   C O M P O N

—When COMP ON is selected, transmitted or printed data will simply be configured with single spaces between each measurement value.
—When COMP OFF is selected, transmitted or printed data will be configured in a “column” format, with a carriage return and line feed after each measurement value.

EXAMPLE: COMP On

```
DEN V0.67 C0.20 M1.23 Y0.77
```

EXAMPLE: COMP Off

```
DEN
V0.67
C0.20
M1.23
Y0.77
```

404A Units Only

- Display resolution (x10) as two place (OFF) or three place (ON)
- Color character set (AID) as V,R,G,B (OFF) or P,C,M,Y (ON)
- Baud rate (output rate of characters per second) for transmitting data via the I/O port
- Decimal point (DTP) enable (ON) or disabled (OFF) during print-out

To set up the I/O port:

1. Press the ▼ button and the COLOR button simultaneously, then release.

   *N cal A Y* appears in the display, where “A” represents Status response.

```
N cal A Y
```

2. Press ▼ to indicate no, you do not want to calibrate.

   *N mode Y* appears in the display.

```
N mode Y
```

3. Press ZERO to indicate yes, you do want to set mode. *X10* appears in the display. Press ZERO to toggle to desired setting, either *X10 ON* or *X10 OFF*

```
^ X10 ON
```
4. When the desired setting appears, press ▼ to select setting. AID ON or AID OFF appears in the display. Press ZERO to toggle to desired setting, either AID ON or AID OFF.

| AID ON |

5. When the desired setting appears, press ▼ to select setting. BAUD plus a baud rate setting appears—either OFF, 300, 600, 1200, 2400, 4800, 9600. Press ZERO again to toggle to the next baud rate setting. Press repeatedly to toggle through all selections.

| BAUD 12 > |

6. When the desired baud rate setting appears, press ▼ to select the setting. DTP ON or DTP OFF appears in the display. Press ZERO to toggle to desired setting, either DTP ON or DTP OFF.

| DTP ON |

8. When the desired setting appears in the display, press ▼ to select the setting and return to normal operation.

RS232 Connector Interface
Your X-Rite 404 instrument can be connected to a computer or printer using a standard RS232 9-pin connector.

For more information on Serial Input Commands and remote control operation of the 404 contact X-Rite Instrument Services.
X-Rite 404 Color Reflection Densitometer
Frequency of Calibration
Under long operating conditions, the instrument should be calibrated once per week, or whenever the instrument displays a message regarding calibration. You should perform a “long calibration” whenever possible. However, you can also perform a Quick-Cal™ procedure any time after an initial long calibration has been performed.

Before calibrating, you should determine the appropriate densitometer response setting for your instrument, based on your production control requirements.

RESPONSE SETTINGS
A densitometer’s measurement system consists of several different components (lamp, optics, light sensor). Different densitometers consist of different types of these components. The density readings measured by these systems are called densitometer response. Because components differ among densitometers, standard responses have been established in the industry. These standards ensure that even instruments with different components will measure in accordance with the same response.

With the complete set of optics—for version 404A, 404G, and 404E—your versatile 404 instrument allows you to utilize five different densitometer response settings.
Descriptions of Available Responses
Using 404G optics, your 404 instrument can use the following responses:

- Status T—ANSI Status T Computerized Color Response is wideband response most typically used in the North American graphic arts industry. This status is used to calibrate the instrument to the T-Ref™ color reference.

- Status G—X-Rite Graphic Arts Response is a wideband response that is similar to Status T, except that it is more sensitive to denser yellow inks.

Using 404E optics, your 404 instrument can use the following responses:

- Status E—European utilizes the Wratten 47B filter—for higher readings in yellow—instead of the Wratten 47 filter typically used in North America.

- Status I (displayed as Status)—Spectrodensitometric response is computer corrected and designed for use with process inks on paper. Measurements other than process inks may produce measurement data with slight discrepancies. NOTE: The 404 displays this Status as StatusN.

Using 404A optics, your 404 instrument can use the following response:

- Status A—used for photo finishing applications.

Selecting Response (404G and 404E only)
To select the appropriate response:

1. First, if this is your first time selecting response, you should plug your instrument in using its AC adapter. This will prevent the microprocessor from going into “sleep” mode to save battery power. With the instrument plugged in, you’ll be free to take your time learning this procedure.

2. Press the ▼ button and the COLOR button simultaneously, then release.

_N cal T Y_ appears in the display, where “T” represents Status T response. The instrument is preset to “T” at the factory.
3. Press ▼ to indicate no, you do not want to calibrate. 

   N mode Y appears.

4. Press ZERO to indicate yes, you want to enter modes. RESP T appears.

5. Press ZERO again, then again to toggle the Status selection between T and G (for 404G), or E and N (for 404E). Stop when the desired response is displayed.

6. Press ▼ twice times to return to the main display.

---

NOTE: Separate memory positions store calibration data for each of the four responses. If you change optics or change response setting, you must re-calibration using that response.

You do not need to re-calibrate when you switch to a response for which you have already calibrated.
OVERVIEW OF CALIBRATION PROCEDURES

Calibrating your instrument is crucial to maintaining its measurement stability. It is also important to maintaining measurement agreement between several densitometers at the same site; and making all densitometers calibrate precisely to the same standard reference, such as T-Ref. Your 404 instrument’s Computerized Color Response™ allows you to use one of three different calibrations procedures to address these factors (404A does not utilize CCR™):

1. Long Calibration allows you to calibrate your instrument to any color reference. This procedure will be used before you take your first measurements for each response. After this calibration procedure has been performed, you can use Quick-Cal™ (see below) to quickly re-calibrate when necessary.

2. Color Correlation Calibration allows you to set the 404 to measure in agreement with another densitometer that has the same response (for example, two wideband densitometers).

3. Quick Cal™ allows you to quickly re-calibrate to white without having to re-measure the black and/or color patches.
404E AND G LONG CALIBRATION

1. If this is your first time calibrating, you should plug your instrument in using its AC adapter. This will prevent the microprocessor from going into “sleep” mode to save battery power. With the instrument plugged in, you’ll be free to take your time learning this procedure.

2. Unlock the Shoe.

3. Press the ▼ and COLOR buttons simultaneously until N cal T Y appears in the display. T stands for the default Status T Response; if you have a different response selected, its initial letter will appear in this position. (See “Selecting Response” earlier in this chapter.)

   ![N cal T Y]

4. Press ZERO to indicate Yes, you do want to calibrate.

   ![N Q cal Y]

5. Press ▼ to select long calibration. SET LO appears in the display for a moment.

   ![SET LO]

6. At this point, refer to the front of your Color Reflection Reference Envelope. (Figure 3-1)

   The first value that appears in the display should match the visual (“V”) value for the G Response printed on your envelope under:

   ![Figure 3-1]

   NOTE: Values shown above and in Figure 3-1 are examples—your values may be different.
7. If the values on the envelope and on the display do not match, enter the correct value using the blue and red arrow buttons.

To lower the value:
Press and hold the **ZERO (▼▲)** button, then press ▼ repeatedly to lower the value until the correct value is shown.

To raise the value:
Press and hold the **ZERO (▼▲) button, then press COLOR (▲) repeatedly to raise the value until the correct value is shown.

---

**TIP:** If you need to move the value up or down by a large amount, hold the arrow button down. The numbers will advance faster as you hold it down.

8. Release all buttons, then press **COLOR.** The T Response value for cyan (C) appears. It should match the value printed on your Reference Envelope.

<table>
<thead>
<tr>
<th>STEP 1 (WHITE)</th>
<th>CAL-LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>T V0.07 C0.06 M0.08 Y0.13</td>
<td></td>
</tr>
<tr>
<td>G V0.07 C0.06 M0.08 Y0.13</td>
<td></td>
</tr>
</tbody>
</table>

9. If the values on the envelope and on the display do not match, use the blue and red arrow buttons as specified in #7 to enter the correct value.

10. Follow #8 again for magenta (M), and then again for yellow (Y).
If the envelope and display values do not match for either color, follow #7 to correct.

11. Press **COLOR** again. **SET HI** appears for a moment. Then, the Step 3 (Black) CAL-HI value for the T Response appears. (Figure 3-1)

| SET HI | Tv 1.92H |

12. If the values on the envelope and on the display do not match, use the blue and red arrow buttons as specified in #7 to enter the correct value.

13. Repeat #11 for Step 4 (cyan), Step 5 (magenta), and Step 6 (yellow). Follow #7 if you need to correct the values. (Figure 3-1)

15. Take your Color Reflection Card out of the envelope. Lay it on a flat, steady surface with the color target side facing up. (Figure 3-2)

\textit{Figure 3-2}

16. Read Step 1—the white target patch—by placing the instrument target window crosshairs over the alignment marks, then lowering the head down onto the shoe. One of the filter values for Step 1 appears in the display, then \textit{READ BLK (BLACK)} appears.

17. Read Step 3—the black target patch (not Step 2, the gray patch). One of the filter values for Step 3 appears in the display, then \textit{READ CYAN} appears.

18. Repeat these measurement steps for Step 4 (cyan), Step 5 (magenta), and Step 6 (yellow).

The values that appear for each Step measurement should match the values listed on the envelope for that Step. If they do not, repeat the calibration procedure. If discrepancies continue to exist, contact X-Rite Instrument Services.

If all values were correct, your instrument is calibrated!

If you wish to calibrate to make your instrument measure in agreement with another instrument, perform the following procedures for “Color Correlation Calibration.”
COLOR CORRELATION (CC) CALIBRATION

There are two ways to perform color correlation calibration, which creates measurement agreement between your 404 and another, similar instrument. The method you use depends on the type of calibration reference used by the other instrument.

NOTE: Color correlation between two instruments can best be achieved between two very similar instruments—two that utilize the same Status setting, have the same optics type, aperture size, and polarization (both have—or both do not have—polarization filters).

If the other instrument uses a reference similar to the 404’s—with black, white, cyan, magenta, and yellow ink targets on paper—then use the first set of instructions. If the other instrument uses a reference without CMYK patches—such as a ceramic plaque with white and black only—then use the second set of instructions.

CC Using Master Instrument CMYK Target
1. Calibrate the other, “master” instrument according to its manufacturer’s specifications and instructions.

2. Begin a long calibration procedure for your 404 instrument (see previous section).

3. When you go to verify the calibration values on the calibration reference envelope, use the values for the master instrument’s calibration standard, instead. Use the procedure in #7 of the long calibration instructions to modify the values on your instrument display to match those on the master instrument’s envelope or reference.

4. When calibration is due for either instrument, use the master instrument’s calibration reference.
CC with No Master Instrument CMYK Target

1. Get a pen or pencil and piece of paper ready.

2. Calibrate the master instrument according to its manufacturer’s specifications and instructions.

3. Prepare the master instrument to read low density (white CAL-LO).

4. Measure Step 1 (white) on the 404’s calibration reference using the master instrument. Write down the low density values for visual, cyan, magenta, and yellow.

5. Prepare the master instrument to read high density (black CAL HI).

6. Measure Step 3 (black) on the 404’s calibration reference using the master instrument. Write down the high density values for visual, cyan, magenta, and yellow.

7. Prepare the master instrument to read color patches.

8. Read Steps 4, 5, and 6 (cyan, magenta, and yellow) on the 404’s calibration reference using the master instrument. Write down the density values for each color.

9. Begin a long calibration using your 404 instrument. When you go to set the CAL LO values, verify the visual, cyan, magenta, and yellow values against the low density values you measured with the master instrument. Use the arrow buttons to adjust the values (see #7 of the last section).

10. Press COLOR again to advance to setting the CAL HI values. Verify the visual, cyan, magenta, and yellow values against the high density values you measured with the master instrument. Use the arrow buttons to adjust the values (see #7 of the last section).

11. When you enter the last “CAL HI” value, the instrument recognizes that you have entered measured black values for each color filter. Nocol Y appears in the display, asking if you wish to perform a color correlation calibration.

NOTE: Color Correlation does not appear when using a 404A instrument, advance to Step 15.
12. Press ZERO to indicate yes, you do want to perform a color correlation calibration, or press ▼ if you do not want to read the color correlations.

13. SET cmy appears briefly in the display, followed by the CAL-HI value for cyan. Verify the cyan value against the cyan value you measured with the master instrument. Use the arrow buttons to adjust the value (see #7 of the last section).

14. Verify the magenta and yellow values against the values measured with the master instrument, then adjust the values to match the master values as necessary.

15. READ WHT appears in the display. Measure white, then verify that the value matches the values recorded for each master instrument measurement. The display prompts you to measure Steps 3, 4, 5, and 6 (or only 3 if correlation was not selected). Verify that these values match the master instrument’s measurements, as well.

16. Perform future calibrations of your 404 using this procedure.
404A LONG CALIBRATION

1. Press the ▼ and COLOR buttons simultaneously until cal A Y appears in the display.

2. Press ZERO to indicate Yes, you do want to calibrate.

3. Press ▼ to select long calibration. SET LO appears in the display for a moment.

4. Enter Visual, Cyan, Magenta, and Yellow values for White.

   To lower the value:
   Press and hold the ZERO (▼△) button, then press ▼ repeatedly to lower the value until the correct value is shown.

   To raise the value:
   Press and hold the ZERO (▼△) button, then press ▼ repeatedly to raise the value until the correct value is shown.

5. Press COLOR button to advance.

5. Enter Visual, Cyan, Magenta, and Yellow values for Black.

6. Press COLOR button to advance.

7. Read White patch on reference.

8. Read Black patch on reference.

Calibration is complete.
QUICK CAL™

Once you have performed the long calibration, you can simply perform the Quick Cal™ procedure periodically to set the low density (white) value.

NOTE: In most cases, you should simply perform an entire long calibration if possible.

1. Press ▼ and COLOR simultaneously, then release. N cal T Y appears in the display. T stands for the default Status T Response; if you have a different response selected, its initial letter will appear in this position. (See “Selecting Response” earlier in this chapter.)

2. Press ZERO to indicate yes, you do want to calibrate.

3. Press ZERO to select Quick Cal™ procedure.

4. Read Step 1—the white patch—on the reference card.

   Your instrument is calibrated!

Display Messages

If any display messages that have not been covered in this chapter appear during any of the calibration procedures, see “Miscellaneous Display Messages” at the end of Chapter 3 for an explanation and instructions.
Your 404 instrument can be used for density and density difference measurement functions.

For density measurement, you need to select the desired color measurement method—SINGLE, AUTO, or ALL (page 3-2).

Once this parameter is set, you can set your instrument to evaluate measurement data two different ways:

- As a straight density measurement data. Viewing this data requires no additional setup (page 3-3).
- As a density difference measurement data. This data shows you the amount of difference between the measured density and a pre-set reference density. To view data in this format, you need to establish a reference measurement, and set up the instrument for density difference readings (page 3-5).
SELECTING COLOR MEASUREMENT METHOD

You can choose from three different measurement methods using the density function. The 404A has one additional method called 3 Color.

- **SINGLE** measurement method simply measures and updates the specific color you selected.
- **AUTO** measurement method measures all four colors, then simply updates and displays the most dominant color.
- **ALL** measurement method measures and updates all four colors, and displays the most dominant color.
- **3 Color** measurement method measures and updates c,m,y and displays the most dominant.

To select color measurement method:

1. Press and hold **COLOR**. One of the color measurement methods—**SINGLE, AUTO, ALL or 3 Color**—appears in the display. If the method you want appears, simply wait a moment and the color values will appear again.

   ![SINGLE]

2. If you wish to change the color measurement method, press **COLOR** again, then again to toggle from one method to the next. When the desired method appears, simply wait a moment and the color values will appear again.

   Color measurement method is set.

Determining which Method is Active

The active color measurement method is indicated at the far left when color measurement information appears in the display:

- When **SINGLE** is active, no characters are shown at the far left.
- When **AUTO** is active, the characters “A” and “u” appear to the far left of the display.

   ![1.13D]

- When **ALL** is active, the characters “A” and “l” appear to the far left of the display.
- **404A Only** When 3 Color is active, the characters “3” and “C” appear to the far left of the display.
DENSITY MEASUREMENT

So far, you have performed the procedure to select the color measurement method.

You are now ready to begin taking measurements to check density values on your press sheet color bar. The type of measurement data that will be displayed will depend on the way you set up your instrument earlier in this chapter.

1. Center target window over area to be measured.
2. Lower unit to target window and hold closed.
3. Once measurement data is displayed, release the unit.
4. Measurement data will appear either as a normal density value or difference value.

Viewing Density Measurement Data

There are different settings that will affect the way the measurement data is displayed. Since you just set up these parameters yourself, you should see the data in the format you expect. For example, if you set your instrument parameters to AUTO, your measurement data will appear like this:

```
[ c 1.13D ]
```

“A” and “u” appear to the far left, indicating that the instrument automatically recognized the color—in our example, the color was cyan. And, the “D” after the value will underlined for density difference; not underlined for normal density measurements.
Viewing Measurement Data for Each Color
You can view measurement data in the display for one color at a time. To toggle the display view from one color’s measurement data to the next, press the COLOR button when data is displayed. Each time you press, the display switches from visual to cyan to magenta, and so forth.

<table>
<thead>
<tr>
<th>v 1.13</th>
<th>EXAMPLE: Pressing the COLOR button repeatedly toggles display from one color’s measurement data to the next.</th>
</tr>
</thead>
<tbody>
<tr>
<td>c 1.17</td>
<td></td>
</tr>
<tr>
<td>m 1.18</td>
<td></td>
</tr>
<tr>
<td>y 1.02</td>
<td></td>
</tr>
</tbody>
</table>

If you are using the SINGLE or AUTO measurement method, the data displayed for each color represents the last time that color was measured. If you are using the ALL method, each color’s data represents the amount of that color measured in the last color read. The most dominant color will have the highest density reading.

<table>
<thead>
<tr>
<th>v 0.67D</th>
<th>EXAMPLE: Using the ALL measurement method, all color data is derived from the single most recent measurement. In our example, magenta is the most dominant color.</th>
</tr>
</thead>
<tbody>
<tr>
<td>c 0.20D</td>
<td></td>
</tr>
<tr>
<td>m 1.23D</td>
<td></td>
</tr>
<tr>
<td>y 0.77D</td>
<td></td>
</tr>
</tbody>
</table>

404A ONLY—If 3 Color measurement is selected, the display will always display cyan first; then each depression of the COLOR button sequences through c, m, and y.
Density Functions

DENSITY DIFFERENCE MEASUREMENT

Density difference measurement uses the same parameters as density measurement. To set up for density difference measurement, follow the procedures earlier in this chapter for selecting color measurement method.

To view measurement data as a density difference value between a measured sample and a known reference—instead of the density value of the measured sample—you must first enter a reference measurement.

Entering a Reference Measurement

1. Press ZERO. REF appears for a moment, followed by the current Reference value. If none has been entered, the Reference value is 0.00.

2. To enter a reference value—or change the current reference value—you can either:
   — measure the reference value directly; or
   — manually enter the reference value using the arrow button functions.

To measure the reference value directly:

Measure the color that you wish to use as the reference. Then, press ▼ to return to normal operation.

To enter the reference value manually:

Hold down the ZERO (▼▲) button, then press the ▼ or CAL (▲) button to adjust the value until the desired value is shown. Then, press ▼ to return to normal operation.

TIP: If you need to move the value up or down by a large amount, hold the arrow button down. The numbers will advance faster as you hold it down.
Viewing Density Difference Measurement Data
There are different settings that will affect the way the measurement data is displayed. Since you just set up these parameters yourself, you should see the data in the format you expect. For example, if you set your instrument parameters to AUTO, your measurement data will appear like this:

\[ c \ -0.13 \]

“\( A \)” and “\( u \)” appear to the far left, indicating that the instrument automatically recognized the color—in our example, the color was cyan. And, the “\( D \)” after the value will underlined for density minus reference measurements; not underlined for normal density measurements.

A “negative” value indicates that the sample was measured to have less density than the reference. If a positive value appears, the sample was measured to have more density than the sample. If 0.00 appears, the sample was measured to have the same density as the reference.
MISCELLANEOUS DISPLAY MESSAGES

During normal operation, some additional display messages may appear. Following are these messages, what these messages mean and what action must be taken when they appear.

BAT LO indicates that the batteries are getting low and will soon need to be charged. BAT LO only appears while the measurement is in progress. Once BAT LO is displayed, you will have approximately 100-200 measurements remaining before charging is required.

CHARGE indicates that the batteries are too low to operate the unit and must be recharged. CHARGE does not appear until you begin the recharge cycle. Thereafter, the unit will be functional and all previous data will be accessible.

D TOO HI indicates density value measured is too high. Make sure you are measuring the right color for the measurement sequence and try again.

D TOO LO indicates density value measured is too low. Make sure you are measuring the right color for the measurement sequence and try again.

If D TOO HIGH or D TOO LO continues to appear, re-calibrate the instrument using long calibration (see Chapter 2).

INVALID When the unit is not held down long enough during a measurement, INVALID will display.

LAMP FAIL Measurement lamp has failed. The lamp should be examined and replaced. When this message occurs, you can get out of this condition (after replacing lamp) by pressing ▼ then COLOR then ▼ or waiting until unit powers down.

MEM LOST (Displayed only during power-up) Internal lithium battery is failing. Intermittent connection on Ni-Cad batteries.
404 Color Reflection Densitometer
SERIAL INTERFACE INFORMATION

The connector used for serial input/output is a Modular 10 circuit type. Figure 4-1 is the connection diagram.

*Figure 4-1*

![Diagram of Serial Interface Connection](image-url)
An RS232 to modular interface adapter is available from X-Rite which performs as shown in the diagram on the previous page. This adapter also provides a jack for the AC adapter so that only one cable need be connected to the 404. Also, when the adapter is not connected to the jack, the +V CHARGER is connected to pin 9 of the DB25 in the diagram. The charger ground is connected to the jack ground only.

The part numbers for these interface adapters are: P/N 418-70 (male DB25 connector) P/N 418-71 (female DB25 connector) See “Accessories” later in this chapter for other adapters.

A 10-foot modular to modular cable for connection of the 404 to the interface adapter is available by ordering P/N SE108-69.

Term Definitions
Pin 2 Transmitted Data: Data transmitted from the densitometer with parameters (baud rate, format) set by the densitometer.

Pin 3 Received Data: Data received by the densitometer from outside source using the same parameters as the densitometer.

Pin 4 DTR (Data Terminal Ready): Logic 0 active (On Line) and Logic 1 during: Power Off, Power Up, Self Test, during measurements, and when serving RCI.

Pin 5 PIN 5 is set to CTS=logic 0 active; if set to BUSY=logic 1 active; and if set to OFF=ignored.

Pin 7: This pin is used for supplying 12VDC @ 700ma for charging the 404 without having the Adapter connected directly to the unit.

Input Characteristics
Logic 1=+.8VDC to -25VDC
Logic 0=+2.25VDC to +25VDC

Output Characteristics
Logic 1=approximately -4VDC
Logic 0 = approximately +5VDC

Outputs are @ 0VDC during Power Down.
A typical interconnection between the 404 and a computer—in its simplest form—is shown in Figure 4-2.

*Figure 4-2*

![Diagram showing interconnection between 404 and computer](image)

**Serial Output**
The data format that is transmitted from the 404 is determined by the I/O PORT options found in Chapter 1 under “I/O Port Setup.”

Data transmitted by the 404 shall have one start bit (Logic 0), 7 bits of ASCII, one parity bit (set to Logic 0), and then one stop bit (Logic 1).

**Serial Input Commands**
Your 404 is equipped with an input that allows the 404 to be controlled or monitored remotely. Every function that can be performed by the 404 (plus a few special functions not activated by the keyboard) can be activated via the serial input. This Remote Control Interface is covered by U.S. Patent 4,591,978.

For more information on Serial Input Commands and remote control operation of the 404, request RS-232 Interface manual P/N 404-506 or P/N 418-506.
INSTRUMENT SPECIFICATIONS

Display
Dot Matrix LCD

Measuring Geometry
ANSI PH 2.17/DIN 16536 multi-sensor array

Light Source
Filament bulb 3000°K DIN approx. 2856°K ANSI

Receiver
Silicon Photodiode

Color Response
G optics for X-Rite Graphics Art Response w/ ANSI Status T
Computerized Color Response.

E optics w/47B per DIN16536 w/Glass interference type
Computerized Color Response.

A optics for Status A Response.

Measuring Range
0.00D-2.5D for G, E, & A
0.00D-2.20D for GS,ES, G/LP, & E/LP

Reproducibility
±0.01D

Linearity
±0.01D or ±1%

Inter-Instrument Agreement
±0.02D or ±2%

Aperture Diameter
404G,E,A—3.4mm
404GS,ES—1.7mm

Calibration
Automatic with Quick Cal™
Adjusts Zero and Slope for Density
Computerized Color Response™ (except 404A)
Polarization Filter
2 x linear /LP option

Warm Up Time
None

Zero Stability
±0.01D maximum per 8 hours

Slope Stability
±1% maximum per year

Power Supply
Six rechargeable AA NiCad batteries 7.2v total rated @600m Ah (included)

Charge Time
Approximately 14 hours

AC Adapter Requirements
404 90-130VAC, 50-60Hz, 18W Maximum
404X 180-260VAC, 50-60Hz, 20W 12VDC @ 700 maximum
Positive tip

Operating Temperature Range
50°-104°F /10°-40°C

Measurements Per Charge
Approx. 4500 (usage dependent)

Measuring Time
Approximately 0.6 seconds

Weight
800 grams

Dimensions
7.4cm H x 8.cm W x 19.6cm L
ACCESSORIES

Accessories Included
Reflection Reference
Operation Manual
AC Adapter
Carrying Case

Specifications and design subject to change without notice.

Accessories and Replacement Parts Available
Polarization Filter................................. P/N 418-73
Security Cable........................................... P/N 418-75
1.7mm Target Window................................. P/N 418-21-017-KIT
3.4mm Target Window................................. P/N 418-21-034-KIT
1.7mm Aperture......................................... P/N 418-63-017
3.4mm Aperture......................................... P/N 418-63-034
Lamp Assembly........................................ P/N 418-13
G Optics.................................................. P/N 418G-35
G/LP Optics.............................................. P/N 418G/LP-35
GS Optics................................................ P/N 418GS-35
E Optics.................................................. P/N 418E-35
E/LP Optics............................................... P/N 418E/LP-35
ES Optics............................................... P/N 418ES-35
A Optics.................................................. P/N 404A-35
Modular Interconnect Cable........................ P/N SE108-69
DB25P DCE (Null Modem) Interface Adapter...... P/N 418-70
DB25S DCE (Null Modem) Interface Adapter...... P/N 418-71
DB25P DTE (Normal) Interface Adapter............ P/N 418-80
DB25S DTE (Normal) Interface Adapter............ P/N 418-81
DB9P Interface Adapter.............................. P/N 418-90
DB9S Interface Adapter.............................. P/N 418-91
Modular Interconnect Cable for Macintosh® computers with 8 pin mini-DIN connector.................... P/N 418-79

For further information on accessories contact your X-Rite representative or call X-Rite, Inc. at: 1-888-826-3059.
GENERAL CLEANING

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

NOTE: Do not use any solvents to remove ink from the cover.

OPTICS MAINTENANCE

1. Remove Optics assembly by removing sensor nose screws from densitometer housing, and then lifting the assembly upward. (Figure 4-3)

Figure 4-3


4. Clean Optics sensors with camelhair brush and set aside.

5. Carefully remove IR Glass [3] and optional polarizing filter (if installed) from sensor nose [2].

6. Remove dust and lint from inner sensor nose and filter(s) with camelhair brush.
7. Carefully reinstall optional polarizing filter (if used) and IR Glass [3] (holding both by edges) into sensor nose, making sure filter(s) are properly seated.


9. Carefully reinstall Optics assembly into densitometer by facing flat edge of sensor nose to front of densitometer. Work into position until alignment pins and connector pins are properly seated.

10. Insert and tighten sensor nose screws.

**TARGET WINDOW REPLACEMENT**

1. Remove old target window by pushing downward on top of shoe [1]. Clean off any remaining adhesive from shoe. (Figure 4-4)

   *Figure 4-4*

   1. Remove old target window by pushing downward on top of shoe [1]. Clean off any remaining adhesive from shoe. (Figure 4-4)

   2. Turn densitometer over and compress shoe [1] all the way down, and lock shoe.

   3. Remove paper backing from tape strip on new target window [2].


6. Unlock shoe.

LAMP REPLACEMENT

Lamp Removal
1. Remove Optics assembly by removing sensor nose screws [1] from the densitometer housing, and then lifting assembly upward. THE THREE INNER SCREWS ON SENSOR NOSE ARE NOT TO BE REMOVED. (Figure 4-5)

Figure 4-5

2. Once Optics assembly is free, rotate over and remove two screws [4] from the lamp PCB [3]. (Figure 4-6)

Lamp Installation
1. Align the flat edges of Optics PCB [2] and new Lamp PCB [3], and insert into Optics assembly. (figure 4-6)

   **NOTE:** EXTREME CAUTION MUST BE TAKEN WHEN INSTALLING NEW LAMP. DO NOT BEND LAMP LEADS.

2. Insert and tighten the two lamp screws [4].

3. Carefully reinstall Optics assembly into densitometer by facing flat edge of sensor nose to front of densitometer. Work into position until alignment pins and connector pins are properly seated.

4. Insert and tighten sensor nose screws [1]. (Figure 4-5)
PROPRIETARY NOTICE

The information contained in this manual is derived from patent and proprietary data from X-Rite, Incorporated. This manual has been prepared expressly for the purpose of assisting operation and maintenance personnel in their use and general maintenance of the X-Rite 404.

Publication of this information does not imply any rights to reproduce or use it for purposes other than installing, operating, or maintaining the equipment described herein.

This instrument is covered by one or more of the following U.S. patents: #4,080,075; #4,591,978; #5,015,098; and patents pending. Foreign patent numbers provided on request.

THESE PROVISION ARE INTENDED TO STATE ALL OF THE RIGHTS AND RESPONSIBILITIES BETWEEN X-RITE, INCORPORATED AND CUSTOMER. THEY TAKE PLACE OF AND SUPERSEDE ALL WARRANTIES, EXPRESSED OR IMPLIED, AND WHETHER OF MERCHANTABILITY, FITNESS OR OTHERWISE. THE REMEDIES CONTAINED IN THIS OPERATION AND INSTALLATION MANUAL ARE EXCLUSIVE.

CUSTOMER AND X-RITE, INCORPORATED WAIVE ALL OTHER REMEDIES, INCLUDING BUT NOT LIMITED TO, CONSEQUENTIAL DAMAGES.
LIMITED WARRANTY

X-Rite, Incorporated warrants each instrument manufactured by them to be free of defects in material and workmanship for a period of 12 months. THERE ARE NO WARRANTIES OF MERCHANTABILITY OR FITNESS. THIS WARRANTY OBLIGATION IS LIMITED TO SERVICING THE UNIT RETURNED TO THE FACTORY FOR THAT PURPOSE AND EXCLUDES THE LAMP AND NICAD BATTERIES.

The instrument shall be returned with transportation charges prepaid. If the fault has been caused by misuse or abnormal operating conditions, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

A Warranty Registration Card is enclosed with each instrument. The purchaser should fill in the card completely and return it to X-Rite, Incorporated postmarked no later than ten (10) days from the date of receipt. This card registers your system with us for warranty coverage. Once your unit is registered, we are able to maintain a file to help expedite service in case it is needed.

Always include serial number and place of purchase in any correspondence concerning your instrument. The serial number is located at the rear of the instrument.

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

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.