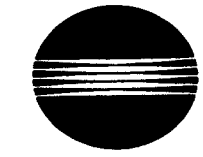
SPECTROPHOTOMETER
CM-508d

INTRODUCTORY MANUAL



MINOLTA

The Minolta Spectrophotometer CM-508d is a compact, handheld instrument for measuring the spectral reflectance of subjects. Battery-powered for portability and with memory space for up to 200 sets of measurement data, the CM-508d is ideal for on-site measurements.

The d/8 (diffuse illumination/8° viewing angle) geometry of the CM-508d, switchable between SCI (specular component included) and SCE (specular component excluded), conforms to ISO and DIN standards, and also meets CIE recommendations for d/0 (diffuse/normal) geometry and ASTM standards for d/0 and t/0 (total/normal) geometry. The spectral reflectance of the subject is measured at a 20nm pitch over the wavelength range from 400 to 700nm, and a double-beam feedback system automatically compensates for variations in the illumination from the CM-508d's pulsed xenon arc lamp. Measurement is almost instantaneous, and measurement results appear in the display in approximately 2 seconds. Measurement results can be calculated based on either the 2° or 10° Standard Observer and any of 11 illuminants (D65, D50, C, A, F2, F6, F7, F8, F10, F11, or F12). Measurement results can then be displayed graphically as spectral reflectance or color difference ($\Delta L^*\Delta a^*\Delta b^*$ or Hunter $\Delta L\Delta a\Delta b$) or as numerical absolute and/or color difference values for L*a*b*, L*C*h, Hunter Lab, Yxy, or XYZ color spaces; CMC (ℓ:c) color difference notation; Munsell notation; metamerism, whiteness (CIE or ASTM E313), yellowness (ASTM D1925 or E313) or brightness (ISO 2470) index. In addition, measurement results based on two selected illuminants can be displayed simultaneously.

Memory space is provided for up to a total of 200 sets of measurement or target color data. For more memory space, a 128KB memory card can be installed, which will provide memory space for up to a total of 1350 sets of data. The CM-508d can also be connected directly to a computer and controlled by the computer, making the CM-508d suitable for use as the sensor of a computerized color system.

Please read the manuals included with the CM-508d before using the instrument for the first time and keep them handy for future reference

NOTES ON USING THESE MANUALS

The instructions for the CM-508d are divided into three manuals:

1 *INTRODUCTORY MANUAL* (this manual): A model-specific manual including information on:
- Names of parts and functions of controls
- System diagram
- Accessory information
- Measuring principle
- Error messages
- Troubleshooting
- Specifications
- Comprehensive index of information in all three manuals

2 *OPERATION MANUAL*: A manual describing general operation of the Spectrophotometer
- Cautions and warnings
- Care and storage
- Preparations (Power, white calibration, zero calibration)
- Menu settings
- Target color operations
- Measurement operations
- Other functions

3 *COMMUNICATION MANUAL*: A manual describing communication between the Spectrophotometer and a separate computer
- Connections
- Communication settings
- Command and data formats

Color mode:

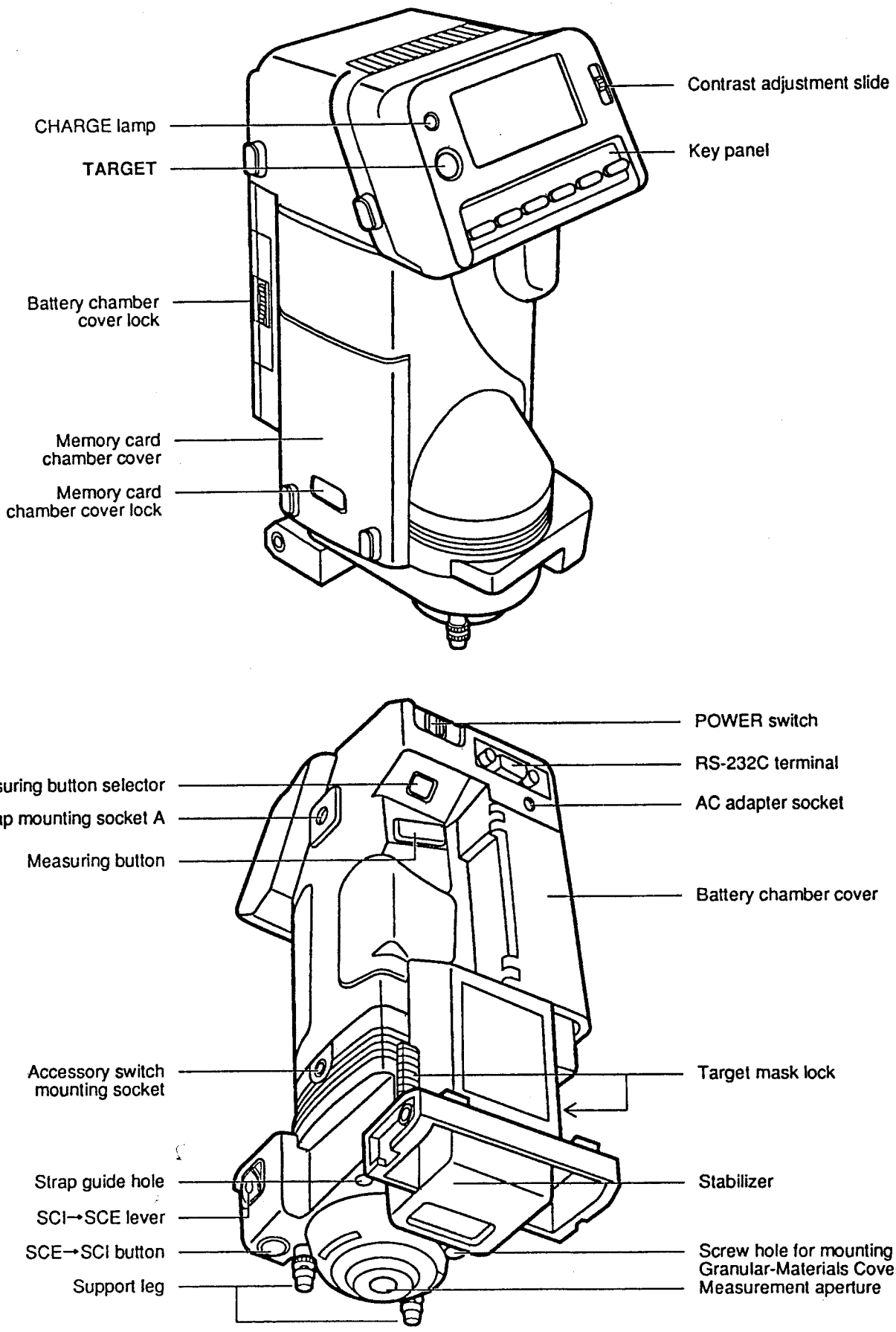
In this manual, the term "color mode" will be used to refer to the following color notations and color-difference formulas: L*a*b*, L*C*h, CMC (ℓ:c), Hunter Lab, Yxy, Munsell, XYZ, yellowness index (ASTM D 1925), yellowness index (ASTM E 313), whiteness index (CIE), whiteness index (ASTM E 313), and ISO 2470 brightness.

WARNING

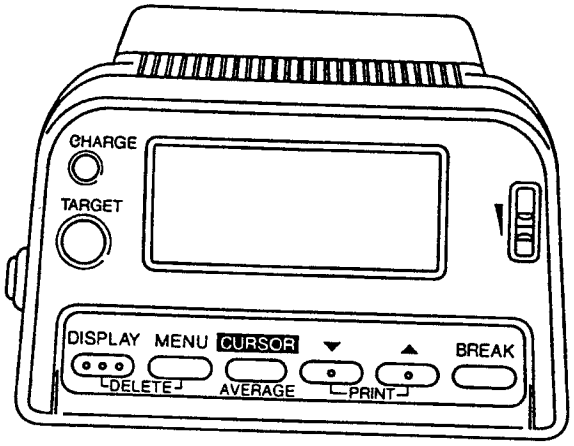
- DO NOT USE THIS INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE, SUCH AS ONE CONTAINING GASOLINE FUMES. USE IN SUCH AN AREA MAY RESULT IN AN EXPLOSION.
- DO NOT DISASSEMBLE THIS INSTRUMENT OR ATTEMPT TO REPAIR IT YOURSELF. THIS INSTRUMENT CONTAINS HIGH-VOLTAGE ELECTRICAL CIRCUITS AND THERE IS A RISK OF ELECTRICAL SHOCK IF THIS INSTRUMENT IS DISASSEMBLED BY UNQUALIFIED PERSONNEL. Any necessary repairs should be performed only by a Minolta-authorized service facility.
- Pay attention to all other cautions and warnings listed in the CM-500d Series *OPERATION MANUAL*.

CONTENTS

NAMES OF PARTS



FUNCTIONS OF CONTROLS



TARGET
- Changes to TARGET mode for setting target color data, tolerance data, etc.

DISPLAY
- Changes between measurement displays for selected DISPLAY setting in measurement mode.
- Changes between MENU displays in MENU mode.
- When pressed together with **BREAK**, causes data to be displayed inverted.

DELETE (DISPLAY and MENU together)
- Deletes presently displayed measurement data or temporarily deletes presently displayed target color data.

MENU
- Enters MENU mode for setting measurement conditions, display functions, data communication functions, etc.

CURSOR/AVERAGE
- Moves cursor when setting data or changing MENU settings.
- In measurement mode or TARGET mode, starts/stops manual averaging sequence.

▼
- Changes settings or changes to next lower specimen number, target number, or numerical value.

▲
- Changes settings or changes to next higher specimen number, target number, or numerical value.

PRINT (▲ and ▼ together)
- Outputs presently displayed data to printer.
- Outputs selected data from memory card to printer when DATA DUMP in <MENU> 4/5 is set to YES.

BREAK
- Returns to next higher display, with measurement display being highest level display.
- When pressed together with **DISPLAY**, causes data to be displayed inverted.

Measuring button selector

NORM.: When measuring button will be used to take measurements.
ACC.: When Accessory Switch CM-A23 is attached and will be used to take measurements.

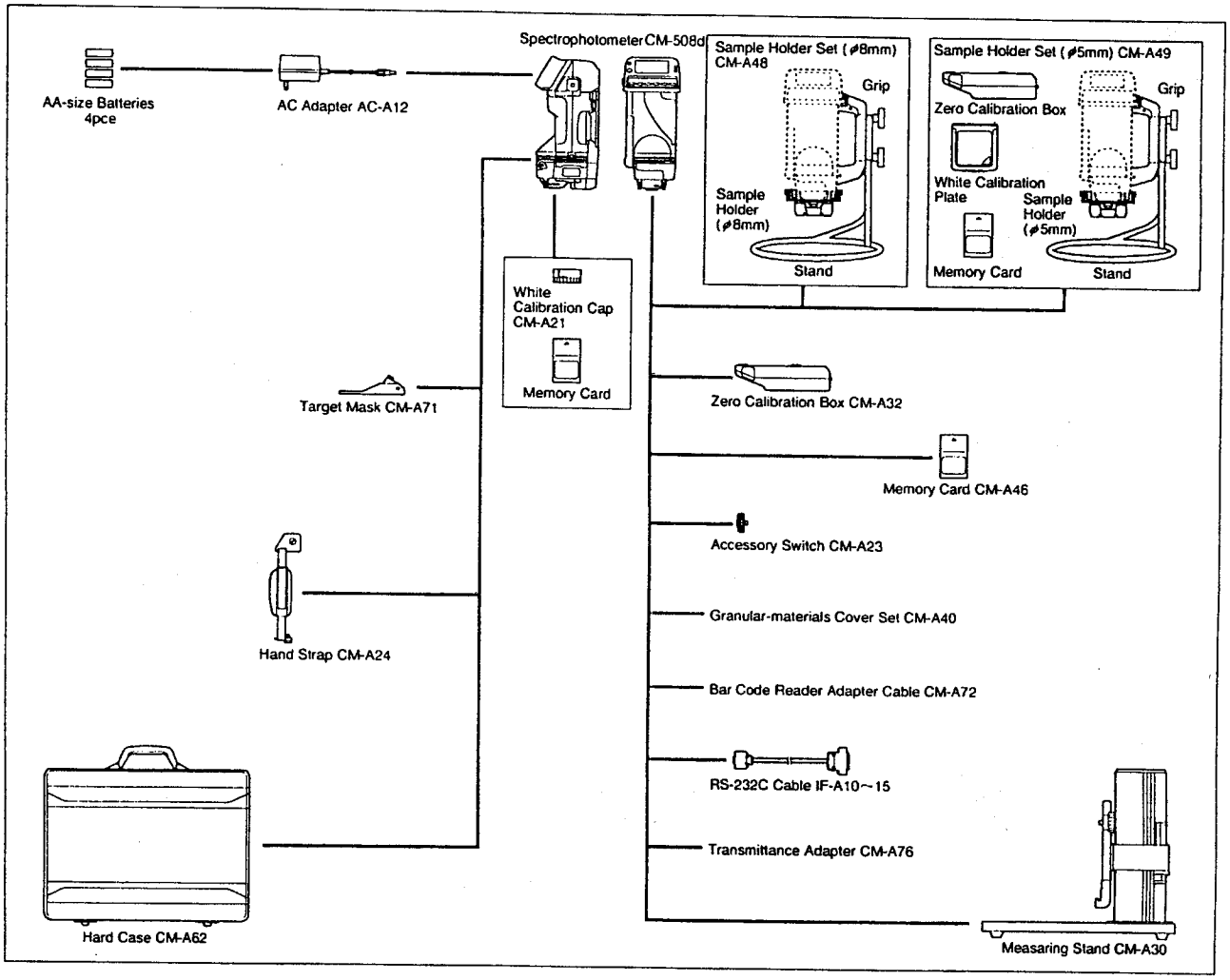
SCI→SCE lever

Switches from SCI measurement to SCE measurement.

SCE→SCI button

Switches from SCE measurement to SCI measurement.

SYSTEM DIAGRAM



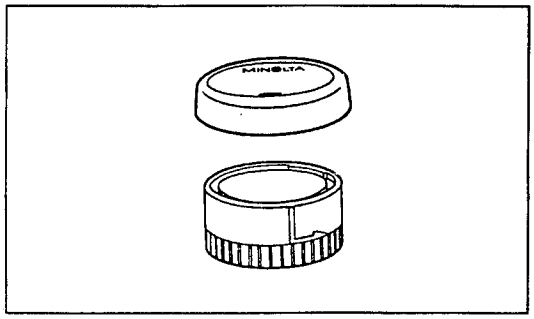
ACCESSORIES

Description

STANDARD ACCESSORIES

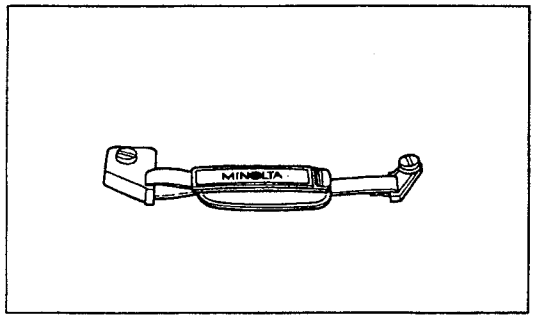
White Calibration Cap CM-A70

White Calibration Cap CM-A70 serves as the white calibration standard for the Spectrophotometer. Calibration data for the cap are listed on the included data sheets. The cap can be attached to the Spectrophotometer when performing white calibration; while attached, the cap also serves to prevent dust, etc. from entering the measurement aperture. A rubber cap is also included to protect the white calibration cap when not in use.



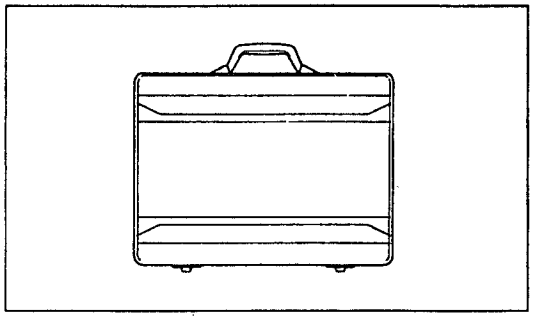
Hand Strap CM-A24

Hand Strap CM-A24 helps users to hold the Spectrophotometer more securely.



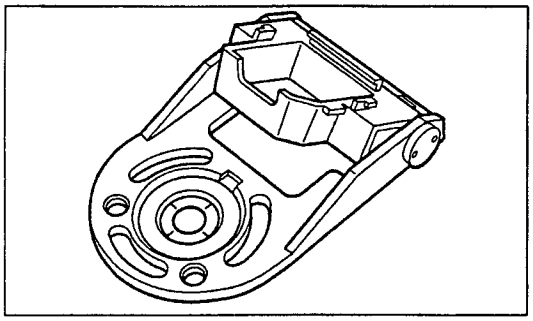
Hard Case CM-A62

Hard Case CM-A62 protects the Spectrophotometer and accessories during storage or transportation. Space is provided for not only the Spectrophotometer itself, but also for instruction manuals and standard accessories such as the White Calibration Cap, AC Adapter, and Target Mask.



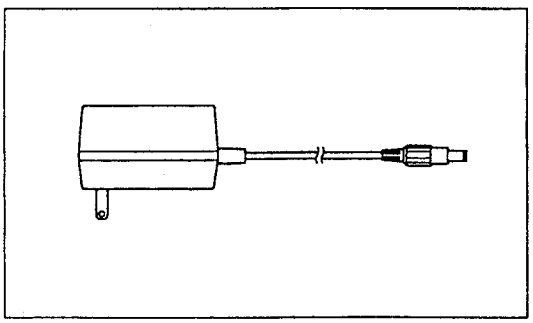
Target Mask CM-A71

Target Mask CM-A71 indicates the area to be measured to help position the Spectrophotometer more accurately. In addition, it keeps sheet materials, such as paper or cloth, flat during measurement.



AC Adapter AC-A12

AC Adapter AC-A12 provides power for the Spectrophotometer from an AC outlet. Output: DC 9V, 1.2A

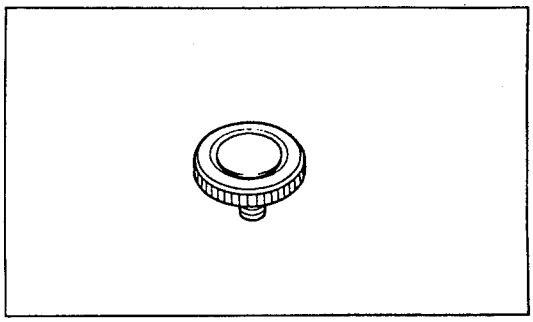


Four AA-size batteries (not shown)

OPTIONAL ACCESSORIES

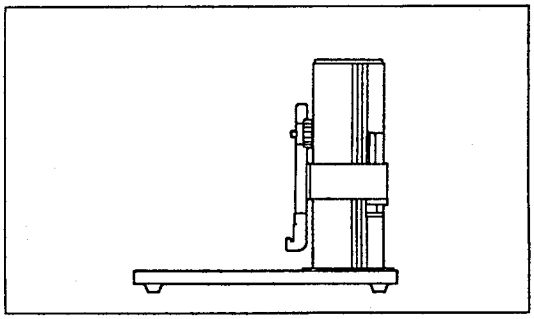
Accessory Switch CM-A23

Accessory Switch CM-A23 attaches to the Spectrophotometer and functions as an additional measuring button. Convenient when holding the Spectrophotometer with two hands and measuring a vertical surface, such as a wall.



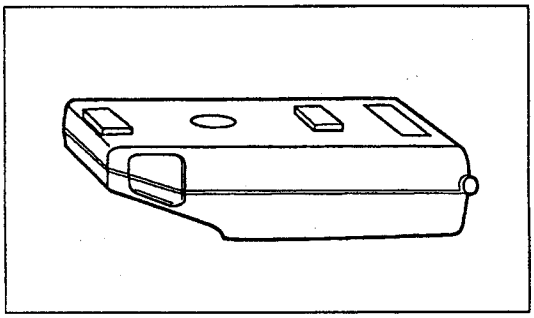
Measuring Stand CM-A30

Measuring Stand CM-A30 enables accurate positioning of the Spectrophotometer and keeps measuring conditions consistent.



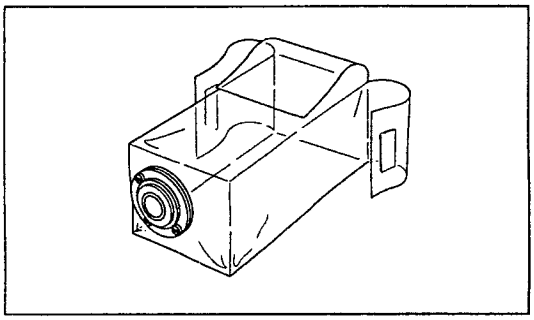
Zero Calibration Box CM-A32

Zero Calibration Box CM-A32 allows accurate zero calibration to be performed easily.



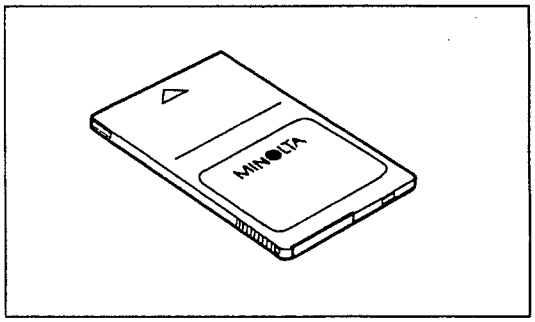
Granular-Materials Cover Set CM-A40
Granular-Materials Cover (Replacement) CM-A41

Granular-Materials Cover Set CM-A40 can be used when measuring powdered or paste-like substances. The set consists of a glass plate which prevents the specimen from entering the measurement aperture and a vinyl cover which protects the Spectrophotometer against dust. Granular-Materials Cover (Replacement) CM-A41 is a replacement vinyl cover which can be used when the original vinyl cover becomes torn.



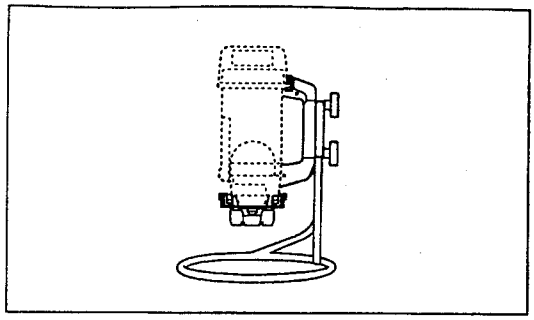
Memory Card CM-A46

Memory Card CM-A46 is a blank 128KB SRAM card which can be used for additional data storage. The card conforms to PCMCIA Ver. 2.1 and JEIDA Ver. 4 standards.



Sample Holder Set (Ø8mm) CM-A48
Sample Holder Set (Ø5mm) CM-A49

Sample Holder Set (Ø8mm) CM-A48 and Sample Holder Set (Ø5mm) CM-A49 enable accurate measurements of thin, flat, lightweight specimens such as paper or cloth. Two different sets, one with an Ø8mm measuring area and the other with a Ø5mm measuring area, are available.



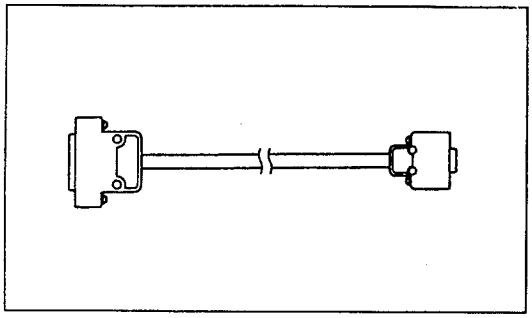
Bar Code Reader Adapter Cable CM-A72

Bar Code Reader Adapter Cable CM-A72 allows a bar code reader to be connected to the Spectrophotometer's RS-232C terminal.

RS-232C Cables IF-A10 to IF-A15

RS-232C Cables connect the Spectrophotometer to a separate computer. The following cables are available:

Cable	Length	Connector
RS-232C Cable IF-A10	2m/6.6 ft.	Male 25-pin D-subminiature
RS-232C Cable IF-A11	5m/16.4 ft.	
RS-232C Cable IF-A12	2m/6.6 ft.	Female 9-pin D-subminiature
RS-232C Cable IF-A13	5m/16.4 ft.	
RS-232C Cable IF-A14	2m/6.6 ft.	Female 25-pin D-subminiature
RS-232C Cable IF-A15	5m/16.4 ft.	

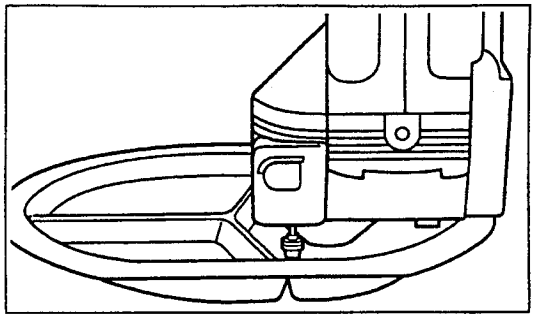


Transmittance Adapter CM-A76

Transmittance Adapter CM-A76 allows the CM-508d to be used for measuring the transmittance of specimens such as liquids, filter glass, or colored plastics using 0/0 geometry.

Stabilizer

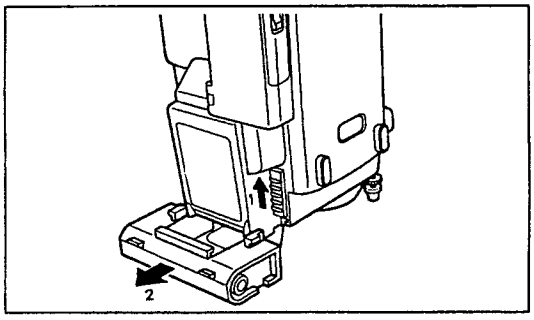
The stabilizer helps keep the Spectrophotometer steady when taking measurements of flat surfaces. It can be removed if necessary to take measurements of concave surfaces.



REMOVING

1 Slide the target mask locks up.

2 Slide the stabilizer toward the back of the Spectrophotometer as shown.



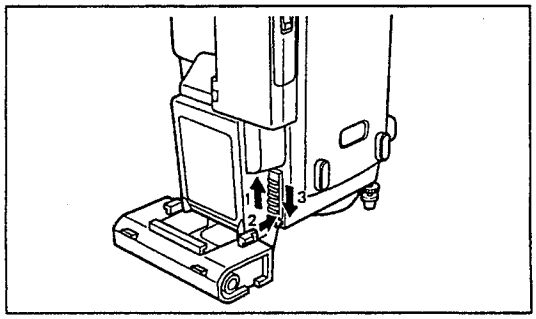
ATTACHING

- If the target mask is attached to the Spectrophotometer, remove it before attaching the stabilizer. See p. I-12.

1 Slide the target mask locks up.

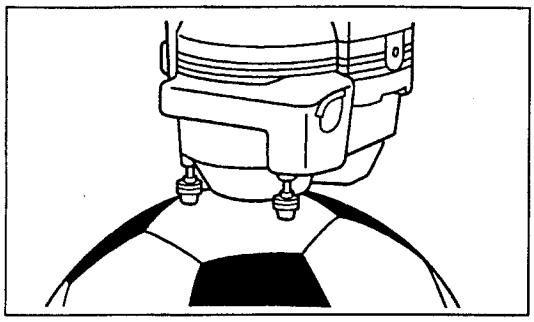
2 Slide the stabilizer rails into the mounting slots of the Spectrophotometer as shown.

3 Slide the target mask locks down.



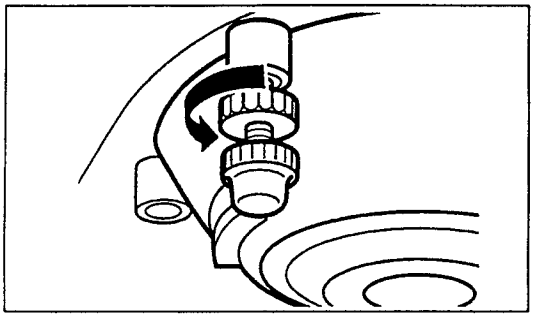
Support Legs

The support legs help to keep the Spectrophotometer steady when measuring slightly convex or concave surfaces. Their height can be adjusted to match the curvature of the surface; the support legs can also be removed when measuring more deeply concave surfaces if the legs prevent the measurement aperture from touching the specimen surface.



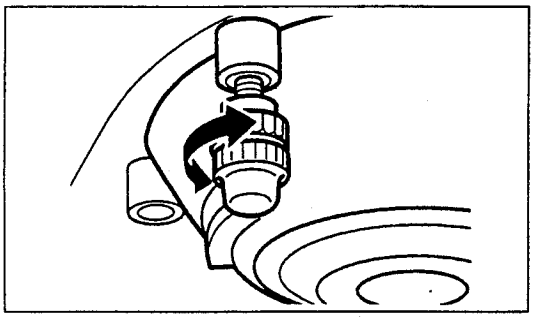
ADJUSTING HEIGHT

1 Loosen the support leg locknut by turning it counterclockwise.

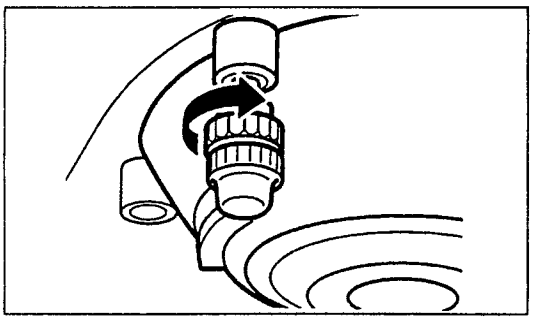


2 Turn the support leg clockwise (to shorten the leg) or counterclockwise (to lengthen the leg) to set the desired height.

- To remove the support leg, turn it counterclockwise until it is free of the Spectrophotometer. To reattach later, align the support leg with the screw hole and turn the leg clockwise.



3 Turn the support leg locknut clockwise until snug to lock the support leg at the set height.



- When measuring curved surfaces, if a surface with a different radius of curvature is measured, the height of the support legs should be readjusted to match the new curvature.

White Calibration Cap CM-A70

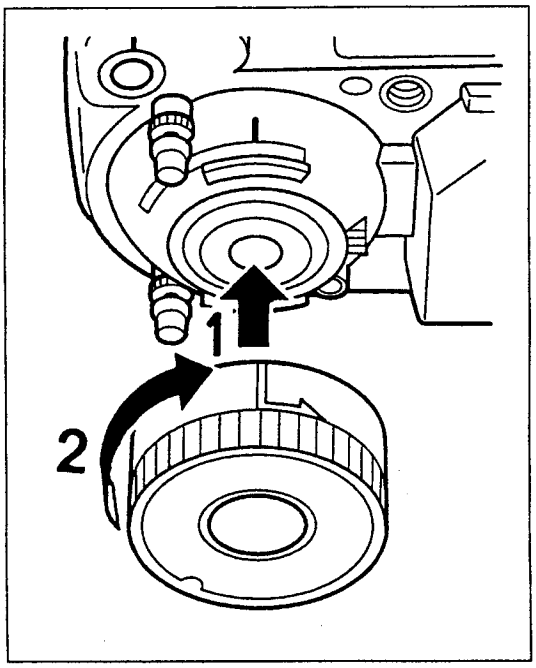
The white calibration cap serves as the white calibration standard for the Spectrophotometer and must be attached to the Spectrophotometer when performing white calibration. In addition, it should be attached to the Spectrophotometer when the Spectrophotometer is stored in order to prevent dust, etc. from entering the measurement aperture.

- When the white calibration cap is not attached to the Spectrophotometer, be sure to attach the included rubber cap to the white calibration cap to protect the white plate inside the white calibration cap from changing color due to exposure to extraneous light.

ATTACHING

1 Align the index mark of the white calibration cap with the index mark of the Spectrophotometer's integrating sphere cover.

2 Press the white calibration cap up against the Spectrophotometer and turn the cap in the direction of the arrow until it stops.

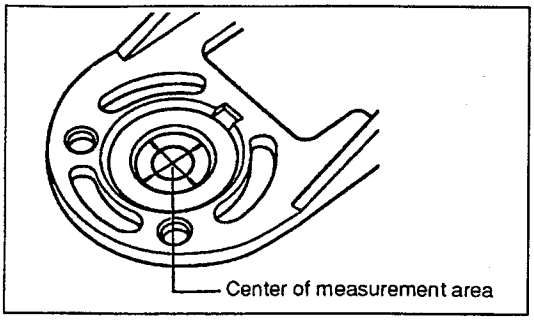


REMOVING

1 Press the white calibration cap up against the Spectrophotometer and turn the cap in the direction opposite to that of the arrow until it stops. The white calibration cap can then be removed.

Target Mask CM-A71

The target mask makes it easy to confirm the specimen point to be measured, allowing more accurate positioning of the Spectrophotometer.



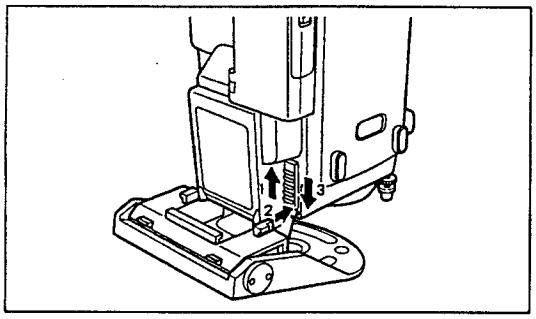
ATTACHING

- If the stabilizer is attached to the Spectrophotometer, remove it before attaching the target mask. See p. I-9.

1 Slide the target mask locks up.

2 Slide the target mask rails into the mounting slots of the Spectrophotometer as shown.

3 Slide the target mask locks down.

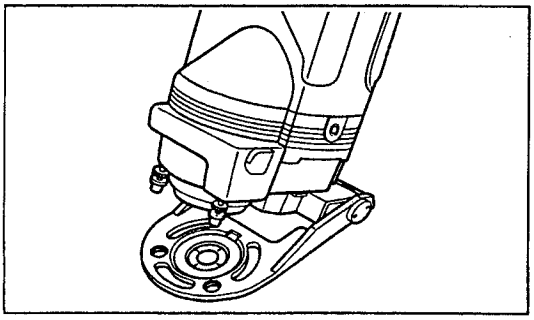


REMOVING

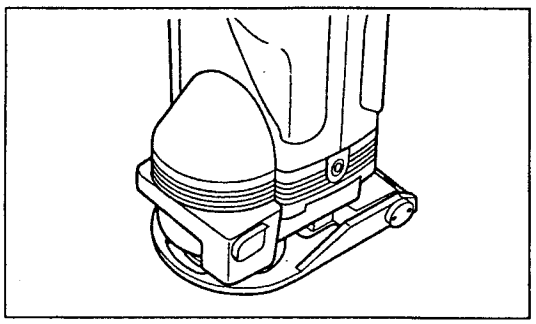
To remove the target mask, reverse the above procedure.

USE

1 Position the Spectrophotometer so that the center of the hole in the target mask is lined up over the center of the specimen area to be measured.

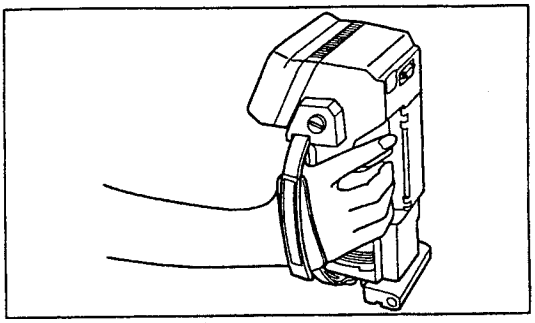


2 Tilt the Spectrophotometer so that the measurement aperture is against the specimen surface, and take a measurement.



Hand Strap CM-A24

The hand strap helps users to hold the Spectrophotometer more securely while taking measurements.

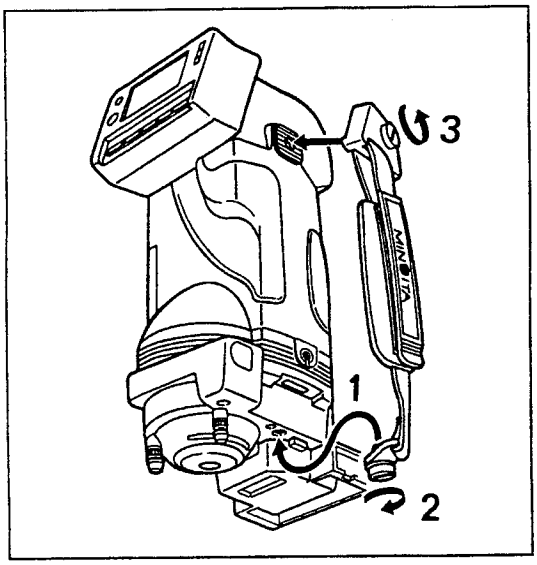


ATTACHING

1 Align the pin of the hand strap's lower mounting plate with the Spectrophotometer's strap guide hole.

2 Align the hand strap's mounting screw B with the Spectrophotometer's strap mounting socket B and turn the screw clockwise until snug. Do not overtighten.

3 Align the hand strap's mounting screw A with the Spectrophotometer's strap mounting socket A and turn the screw clockwise until snug. Do not overtighten.



REMOVING

To remove the hand strap, reverse the above procedure.

Memory Card

The memory card is a 128KB SRAM card that conforms to PCMCIA and JEIDA standards.

- When using a memory card, be sure that the write-protect switch is set to the off position.
- While a memory card is installed, the internal memory of the Spectrophotometer (and the data stored in that memory) cannot be used.
- Never insert or remove a memory card while the POWER switch of the Spectrophotometer is set to | (on). Doing so may result in a malfunction of the Spectrophotometer.
- Although memory cards which have been previously used with Minolta Spectrophotometer CM-2002 or CM-2022 can also be used with CM-500 series models, the card must be initialized with a CM-500 series model before use and all data previously stored on the card will be erased during initialization. Also, once a card has been initialized for use on CM-500 series models, it cannot be used with CM-2002 or CM-2022; if it is used with CM-2002 or CM-2022 by mistake, all data previously stored on the card will be erased.
- Marketed 128KB or 256KB SRAM memory cards conforming to PCMCIA and JEIDA standards can also be used.

STORAGE CAPACITY

The following can be stored on a 128KB memory card:

- Measurement data: Data for maximum of 1350 measurements[1]
- Target color data: Data for maximum of 1349 target colors[1]
- White calibration data: Data for one white calibration standard
- Menu settings: One set of menu settings

[1] The total number of data for measurements and target colors is 1350. If, for example, data for 350 target colors are stored on the memory card, data for only 1000 measurements can be stored. Space for data for one measurement is always maintained. When the total number of stored data for measurements and target colors reaches 1350, subsequent measurements will overwrite the data for the highest specimen number. If data for the maximum number of target colors (1349) has been stored, each measurement will overwrite the data for the previous measurement.

STORAGE OF DATA

Measurement data:	Measurement data are automatically stored on the memory card each time a measurement is taken.
Target color data:	Target color data are automatically stored on the memory card when the data are set (by measurement or by input using keys).
White calibration data:	White calibration data are automatically stored when they are input or changed using keys.
Menu settings:	Menu settings are automatically stored when they are set or changed.

- If a new, blank memory card is installed and the POWER switch of the Spectrophotometer is set to | (on), the presently set white calibration data and menu settings will be copied from the Spectrophotometer memory to the card after initialization of the card has been completed.

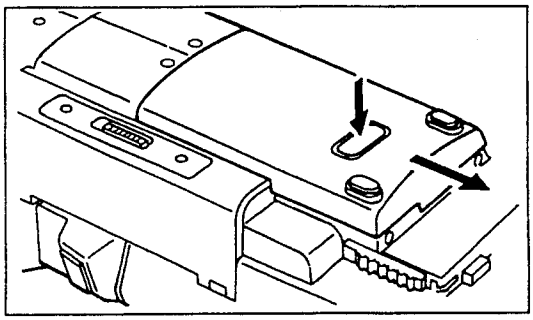
WRITE-PROTECT SWITCH

The memory card is equipped with a write-protect switch which can be used to prevent stored data from being accidentally overwritten when the card becomes full. In order for data to be stored on the card, the write-protect switch must be set to the off position (the position opposite to that indicated by the arrow). If the write-protect switch is set to ON, the error message CARD ERROR will appear in the display and data will not be stored on the memory card.

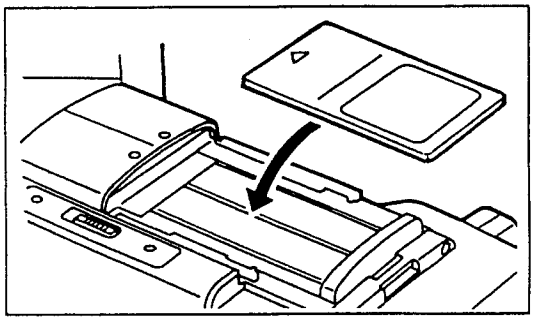
INSTALLING MEMORY CARD

- Always check that the POWER switch of the Spectrophotometer is set to O (off) before installing memory card.

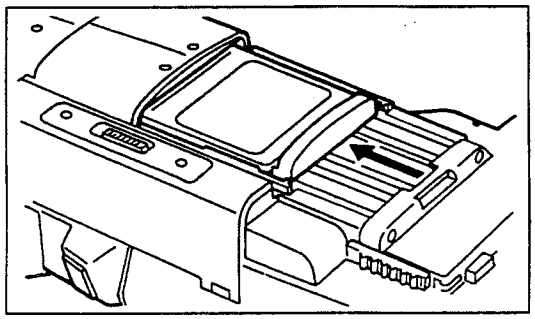
1 While pressing the memory card chamber cover lock, slide the memory card chamber cover down and remove the cover.



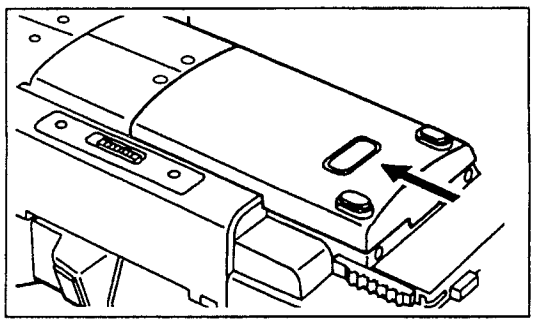
2 Insert the memory card in the memory card chamber.



3 Slide the memory card insertion/removal slide up fully until the memory card clicks in place.



4 Replace the memory card chamber cover.
   - If the memory card is not installed correctly, the memory card chamber cover cannot be replaced.

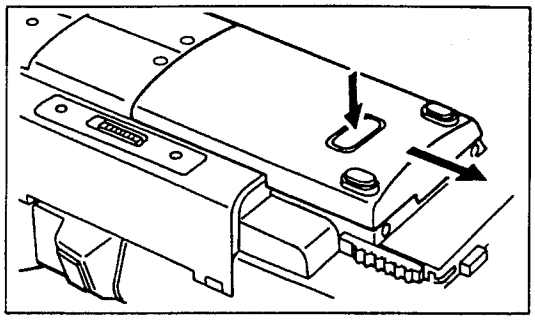


- When a new, blank memory card is installed in the Spectrophotometer and the POWER switch is slid from O (off) to | (on), the initialization display will appear and initialization should be performed (see p. I-18). After initialization has been completed, the white calibration data and menu settings presently stored in the Spectrophotometer's memory will be copied to the memory card. Operation of the Spectrophotometer can then be performed using the white calibration data and menu settings stored on the memory card; white calibration data and menu settings stored in the Spectrophotometer's memory will be protected and will not be affected by any changes made during operation.
- When a memory card containing white calibration data, menu settings, target color data, and measurement data is installed, operation of the Spectrophotometer will be performed using the data stored on the memory card. The memory of the Spectrophotometer will be protected and any data (white calibration, target color, or measurement) or settings stored in the Spectrophotometer' s memory will not be affected by any changes made during operation.

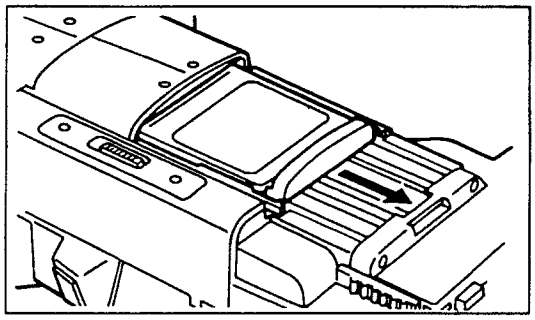
REMOVING MEMORY CARD

- Always check that the POWER switch of the Spectrophotometer is set to O (off) before removing memory card.

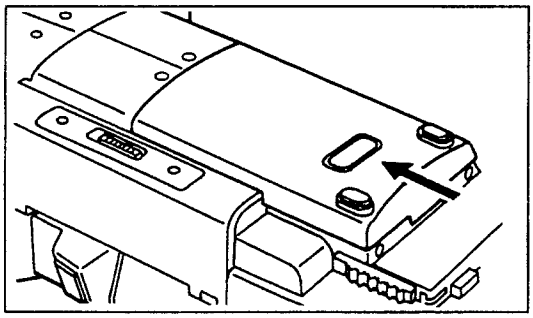
1 While pressing the memory card chamber cover lock, slide the memory card chamber cover down and remove the cover.



2 Pull the memory card insertion/removal slide down fully and remove the memory card.



3 Slide the memory card insertion/removal slide back up and replace the memory card chamber cover.
   - The memory card chamber cover cannot be replaced if the memory card insertion/removal slide is not in the correct position.

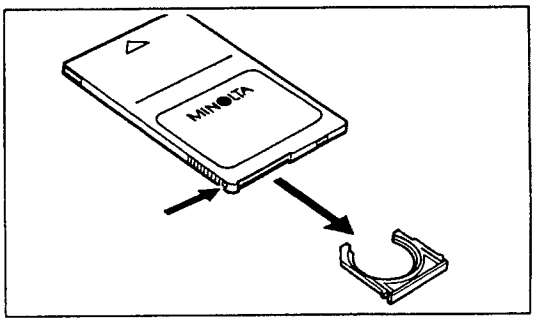


INSTALLING BATTERY

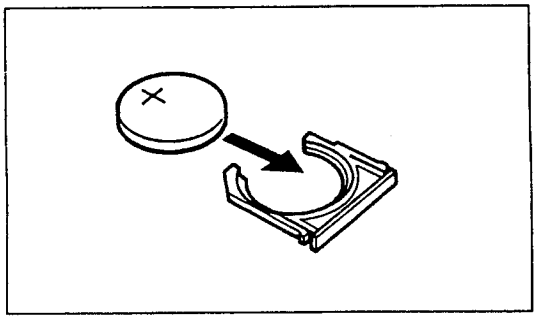
The memory card is equipped with a replaceable battery which maintains the information stored on the card; the memory card also has a built-in rechargeable auxiliary battery to maintain the stored information while the replaceable battery is replaced. If the power of both batteries becomes too low, the stored information will be erased. **The life of the replaceable battery is approximately two years; however, to ensure that data is not lost, it is good practice to replace the battery even before this period has fully elapsed.** Also, extremely important data should be backed up to another memory card or to a floppy disk to avoid any chance of loss.

- The battery of the memory card included as a standard accessory was installed at the factory before shipment on the date written on the back of the memory card. The battery should be replaced within two years from this date.
- The built-in rechargeable auxiliary battery can maintain the stored information for approximately 30 minutes when fully charged. To ensure that the auxiliary battery is sufficiently charged before changing the replaceable battery, install the memory card in the Spectrophotometer, set the Spectrophotometer's POWER switch to | (on), and leave it on for at least 10 minutes before performing the following procedure.

1 Release the battery case lock by pressing on the battery case lock button, and slide the battery case out of the memory card.



2 Remove the old battery and replace with a new CR2325 battery (or equivalent listed below) as shown at right.



3 Reinsert the battery case in the memory card.

4 Write the date of battery installation on the back of the memory card.

Battery Warnings for Memory Card Battery

- CAUTION: The battery used in this device may present a fire or chemical-burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate.
- Remove exhausted batteries promptly. If an exhausted battery is left in the memory card for an extended period of time, battery leakage or corrosion may result.
- Dispose of used batteries promptly.
- Replace battery only with one of the lithium batteries listed below. Use of other batteries may present a risk of fire or explosion.

Manufacturer	Part No.
Fuji Electrochemical Co., Ltd.	CR 2325
Matsushita Electric Industrial Co., Ltd.	BR 2325
Duracell Inc.	DL 2325

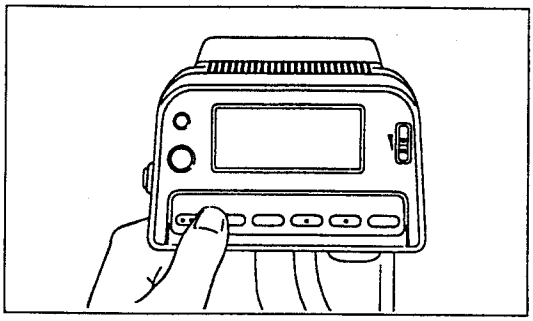
- When installing a battery, be sure to check the battery polarity. The memory card may be damaged if battery is installed with polarity reversed.
- Keep batteries out of reach of small children and animals.
- Never put batteries in mouth. If swallowed, contact your physician or local poison control center.

MEMORY CARD INITIALIZATION

Before using a memory card for the first time, it is necessary to initialize the card according to the following procedure.

1 Install the memory card (see p. I-15) and slide the POWER switch from O (off) to | (on). The startup display sequence will occur for about three seconds and then the initialization display will appear.

2 Press **DELETE** (**DISPLAY** and **MENU** together). The memory card will be initialized, the white calibration data and menu settings presently stored in the Spectrophotometer's memory will be copied to the memory card, and then the display will change to CALIBRATION mode.

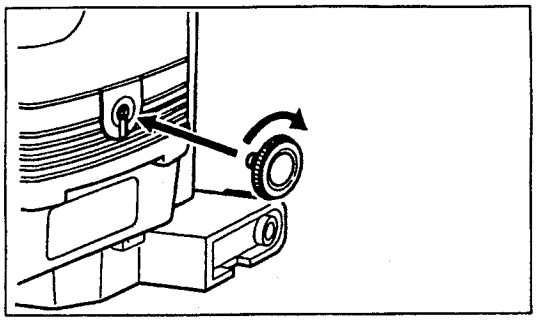


Accessory Switch CM-A23

Accessory Switch CM-A23 is an optional accessory which can be attached to the Spectrophotometer and functions as a second measuring button. It is especially convenient when holding the Spectrophotometer with two hands and aiming the measurement aperture away from yourself, such as when measuring walls and other vertical surfaces or when measuring overhead surfaces.

ATTACHING

Align the screw of the Accessory Switch with the Spectrophotometer's accessory switch mounting socket and turn the switch clockwise until snug. Do not overtighten.



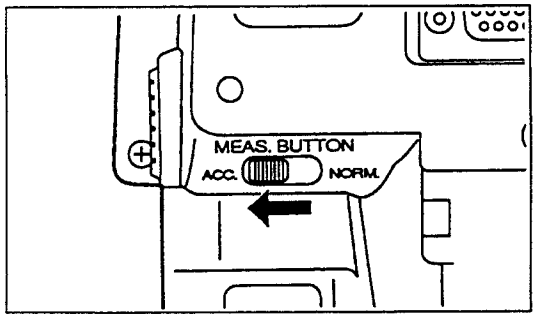
REMOVING

Turn the Accessory Switch counterclockwise until it is free of the Spectrophotometer.

USE

To take measurements using the Accessory Switch, set the measuring button selector to **ACC**.

- The displayed data can be inverted for easier viewing if desired by pressing **DISPLAY** and **BREAK** at the same time. To return the display to normal, press **DISPLAY** and **BREAK** at the same time again.



MEASURING PRINCIPLE

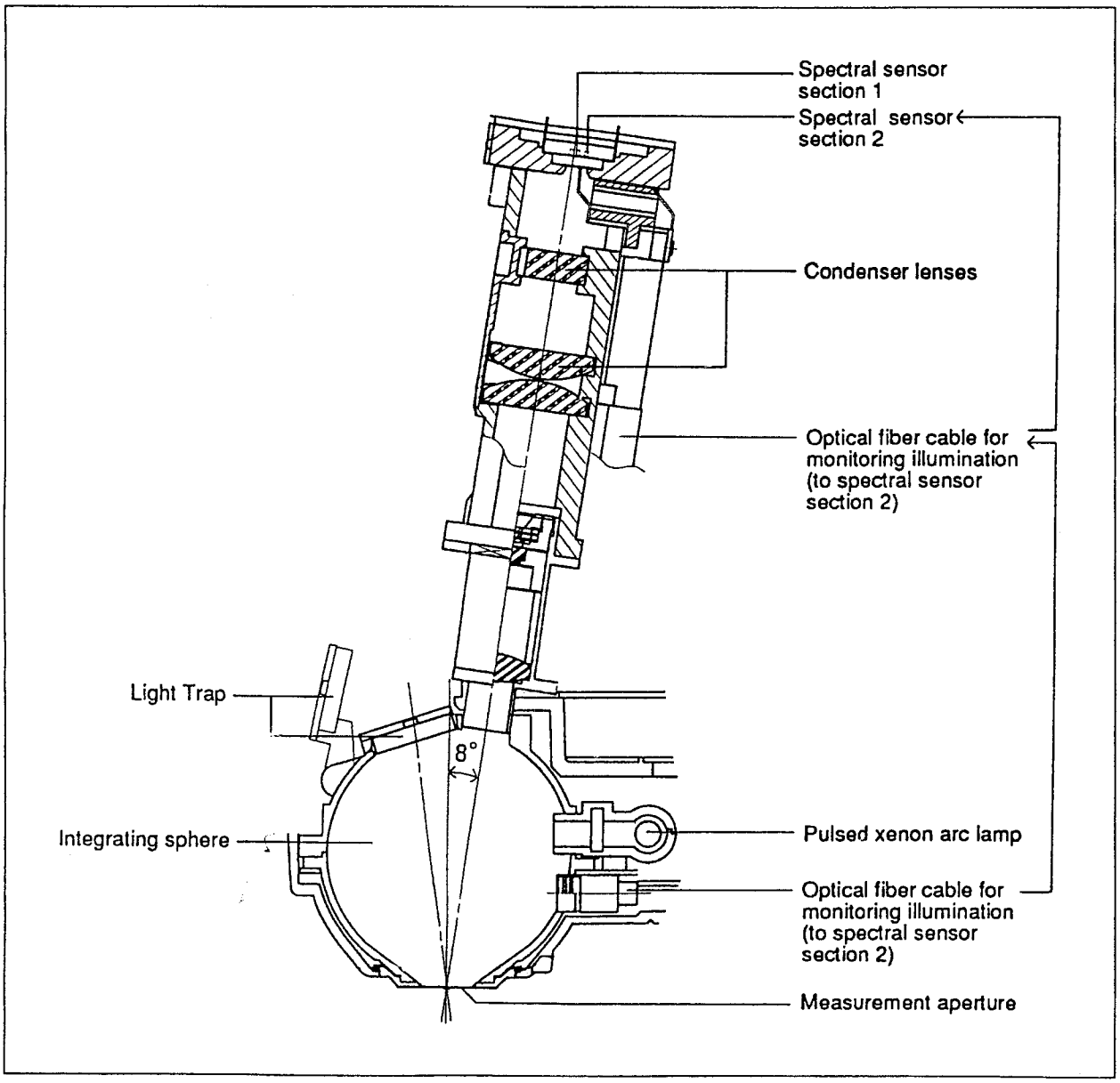
Illuminating/Viewing System

The illuminating/viewing system of the Spectrophotometer is shown in the diagram below. In this system, the specimen surface is illuminated diffusely and viewed at an angle of 8° to the normal to the specimen surface; this geometry is termed d/8 (diffuse/8°). The system also allows users to switch between SCI (specular component included) and SCE (specular component excluded) measurements (see p. 21). The illuminating/viewing geometry meets the specifications for d/8 geometry described in ISO 7724/1[1] and DIN 5033 Teil 7[1]; in addition, the system also meets the recommendations for d/0 (diffuse/normal) geometry published in CIE Publication 15.2[2] and the ASTM E 1164 specifications[3] for d/0 (diffuse/normal; SCE) and t/0 (total/normal; SCI) geometries.

1 ISO 7724/1 and DIN 5033 Teil 7 state that for d/8 geometry, the angle between the viewing beam and the normal to the specimen should be 8°±2° and that the angle between the axis of the viewing beam and any ray within that beam should not exceed 5°. The axis of the Spectrophotometer's viewing beam is at an angle of 8° to the normal to the specimen with a total beam width of 7.4° and thus meets these specifications.

2 CIE recommendations state that for d/0 geometry, the angle between the viewing beam and the normal to the specimen surface should not exceed 10° and that the angle between the axis of the viewing beam and any ray within that beam should not exceed 5°. The axis of the Spectrophotometer's viewing beam is at an angle of 8° to the normal to the specimen with a total beam width of 7.4° and thus meets these specifications.

3 ASTM E 1164 specifies that for t/0 geometry, the angle between the viewing beam and the normal to the specimen surface should not exceed 10° and that the angle between the axis of the viewing beam and any ray within that beam should not exceed 5°. The axis of the Spectrophotometer's viewing beam is at an angle of 8° to the normal to the specimen with a total beam width of 7.4° and thus meets these specifications.



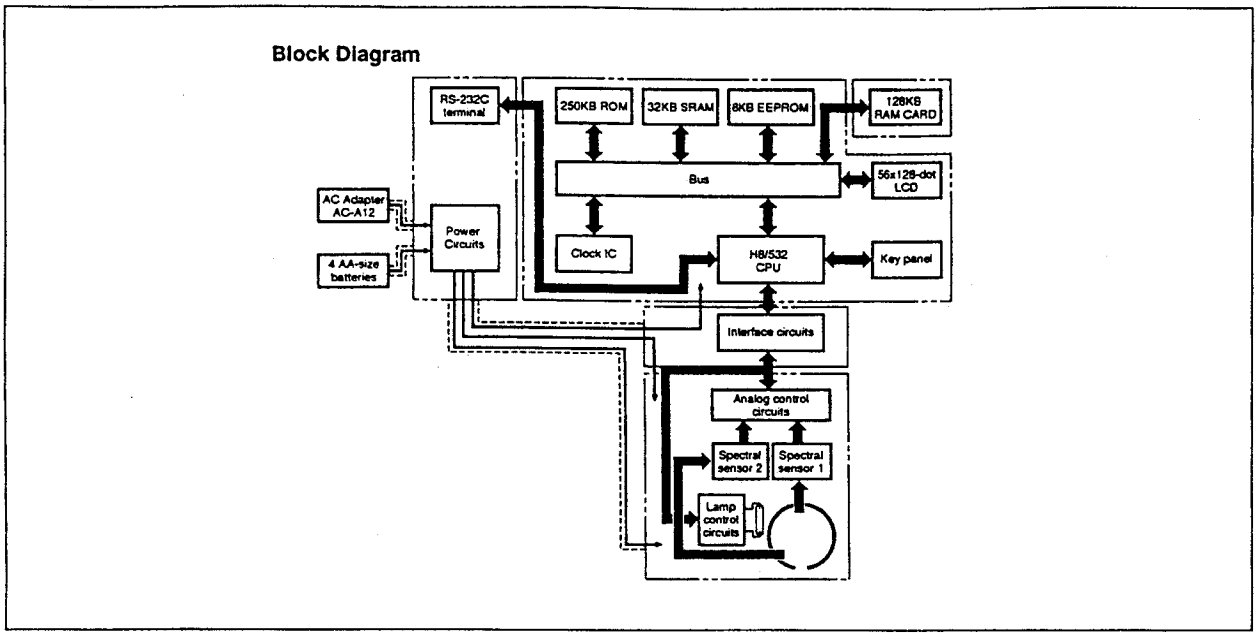
The Spectrophotometer utilizes a pulsed xenon arc lamp for illumination; light from the lamp is thoroughly diffused inside the integrating sphere to provide diffuse even lighting over the illuminated area of the specimen surface. The spectral sensor of the Spectrophotometer is divided into two sections for use by the double-beam feedback system; one section receives the light reflected by the specimen surface, and the second section monitors the light inside the integrating sphere. By utilizing two sections of the spectral sensor in this way, the effects of slight variations in the spectral characteristics or intensity of the illumination can be eliminated by calculation.

SPECULAR COMPONENT INCLUDED/SPECULAR COMPONENT EXCLUDED

The illuminating/viewing geometry of the Spectrophotometer allows users to switch between SCI (specular component included) and SCE (specular component excluded) measurements. SCI measurements include both light reflected diffusely from the specimen surface and light reflected specularly from the specimen surface; such measurements provide results with minimal influence from the specimen's surface conditions. SCE measurements include only light reflected diffusely from the specimen surface; such measurements provide results which closely match those of visual evaluation by a trained observer.

Switching between SCI and SCE measurements is accomplished on the Spectrophotometer by closing and opening a small door leading to a light trap. This door is positioned directly opposite the viewing optical system at an angle of 8° to the normal of the specimen surface. When the door is closed, SCI measurements are performed; light reflected specularly from the specimen surface is reflected back to the specimen surface and then into the viewing optical system. When the door is open, SCE measurements are performed; light reflected specularly from the specimen surface passes through the hole in the integrating sphere uncovered by the door and enters a light trap, which prevents the light from re-entering the integrating sphere.

Component Block Diagram



Measurement Process

The basic flow of operations during a measurement cycle is as follows:

1 Pre-flash (see below) is performed to determine the suitable intensity of light for measurement.

2 Light of this intensity is then produced by the pulsed xenon arc lamp, is thoroughly diffused inside the integrating sphere, and then evenly illuminates the specimen surface.

3 Light reflected from the specimen surface at an angle of 8° to the normal enters the optical fiber cable for taking measurements and is transmitted to spectral sensor section 1. At the same time, the light inside the integrating sphere (the light which illuminates the specimen surface) enters the optical fiber cable for monitoring illumination and is transmitted to spectral sensor section 2.

4 The light from each optical fiber cable strikes the corresponding section of the spectral sensor, where it is divided by wavelength (from 400 to 700nm at 20nm intervals). The segments of the spectral sensor convert the received light into electrical currents proportional to the intensity of the light. These electrical currents are then passed to the analog control circuits.

5 The analog control circuits convert the currents into proportional analog voltages, and then into digital signals.

6 The digital signals are input to the CPU, which performs various calculations to determine the spectral reflectance values. These values are stored in the Spectrophotometer's internal RAM if no memory card is installed; if a memory card is installed, the data is stored on the memory card instead of in the internal RAM.

7 The CPU then performs further calculations according to the menu settings of the Spectrophotometer and displays the results in the LCD panel.

PRE-FLASH FUNCTION

The Spectrophotometer is equipped with a pre-flash function which determines the light intensity suitable for measurement according to the reflectance of the specimen surface. When a measurement cycle is started, the pulsed xenon arc lamp is caused to fire at low intensity (2% of maximum intensity). The light reflected from the specimen surface as a result of this low-intensity pre-flash is used by the Spectrophotometer to determine the maximum spectral reflectance of the specimen surface and the wavelength at which this occurs. The xenon lamp is then fired again to take the actual measurement, with the intensity of the light from the xenon lamp adjusted based on the pre-flash results so that a specific amount of light will be reflected from the specimen surface at the wavelength determined by the pre-flash process. In this way, only the necessary amount of light is used for measurements: High-reflectance specimens are measured using a small amount of light, and low-reflectance specimens are measured using a large amount of light. As a result, repeatability for low-reflectance specimens is improved and power consumption is reduced.

ERROR MESSAGES

- If any of the following messages continue to appear and normal operation cannot be resumed, contact the nearest Minolta authorized service facility.

Message	Problem	Corrective action
ADDRESS ERROR	Internal program is running wild due to excessive electrical noise (power fluctuations, etc.) or component malfunction	Set POWER switch to O (off) for a moment, then set it back to | (on). If this message reappears, contact the nearest Minolta authorized service facility.
A/D ERROR	Error in Spectrophotometer's A/D converters.	Set POWER switch to O (off) for a moment, then set it back to | (on). If this message reappears, contact the nearest Minolta authorized service facility.
CARD BATTERY	Power of memory card battery is low.	Replace memory card battery with new one.
CARD ERROR	Memory card cannot be accessed.	Check that memory card is installed correctly.
		Set memory card's write-protect switch to off position.
		Replace memory card with new one.
CHARGE ERROR	Lamp circuit has not finished charging.	Wait until CHARGE lamp is lit before attempting measurement.
DATA SET ERROR	Input numerical target color data unacceptable (for example, when data are converted to XYZ values, one or more values are negative).	Input acceptable target color data.
DIFF. CONDITIONS CAN'T CALCULATE	Present settings of illuminant and observer are different than those set when target color data was set numerically.	Set illuminant and observer to same settings as when target color data was set numerically, or set target color data again with present settings of illuminant and observer.
EEPROM ERROR	Error in Spectrophotometer's EEPROM.	Contact the nearest Minolta authorized service facility.
FLASH ERROR	Pulsed xenon arc lamp did not flash.	Perform measurement or calibration again. If this message reappears, contact the nearest Minolta authorized service facility.
		If this message appears in succession with LOW BATTERY, replace batteries with new ones or use AC adapter and perform measurement or calibration again. If this message reappears, contact the nearest Minolta authorized service facility.
ILLEGAL ERROR	Internal program is running wild due to excessive electrical noise (power fluctuations, etc.) or component malfunction	Set POWER switch to O (off) for a moment, then set it back to | (on). If this message reappears, contact the nearest Minolta authorized service facility.
INVALID TARGET	Present settings of illuminant and observer are different than those set when target color data was set numerically.	Set illuminant and observer to same settings as when target color data was set numerically, or set target color data again with present settings of illuminant and observer.
LOW BATTERY	Battery power is low.	Replace batteries with new ones or use AC adapter.
LOW ILLUMINANT	Monitored illumination inside integrating sphere is low.	If this message appears alone, contact the nearest Minolta authorized service facility.
		If this message appears in succession with LOW BATTERY, replace batteries with new ones or use AC adapter and perform measurement or calibration again. If this message reappears, contact the nearest Minolta authorized service facility.
MC COVER	Memory card cannot be accessed because memory card chamber cover is open.	Close memory card chamber cover.
MEMORY FULL	When memory card is not installed: Memory of Spectrophotometer is full.	Delete measurement data or target color data.
		Install memory card.
	When memory card is installed: Memory card is full.	Install new memory card.

Message	Problem	Corrective action
NO W. CAL	White calibration was not performed at the present SCI/SCE setting after POWER switch was set to | (on).	Set POWER switch to O (off), set it back to | (on) to set Spectrophotometer to CALIBRATION mode, and then perform white calibration at the present setting.
SRAM ERROR	Error in Spectrophotometer's SRAM.	Contact the nearest Minolta authorized service facility.
TIME OUT	Data could not be output because CTS input of Spectrophotometer was OFF.	Check that internal connections of RS-232C cable are correct and that cable is connected correctly.
		Check CTS input.
		Check status of receiving device.
ZDIV ERROR	Internal program is running wild due to excessive electrical noise (power fluctuations, etc.) or component malfunction	Set POWER switch to O (off) for a moment, then set it back to | (on). If this message reappears, contact the nearest Minolta authorized service facility.

TROUBLESHOOTING GUIDE

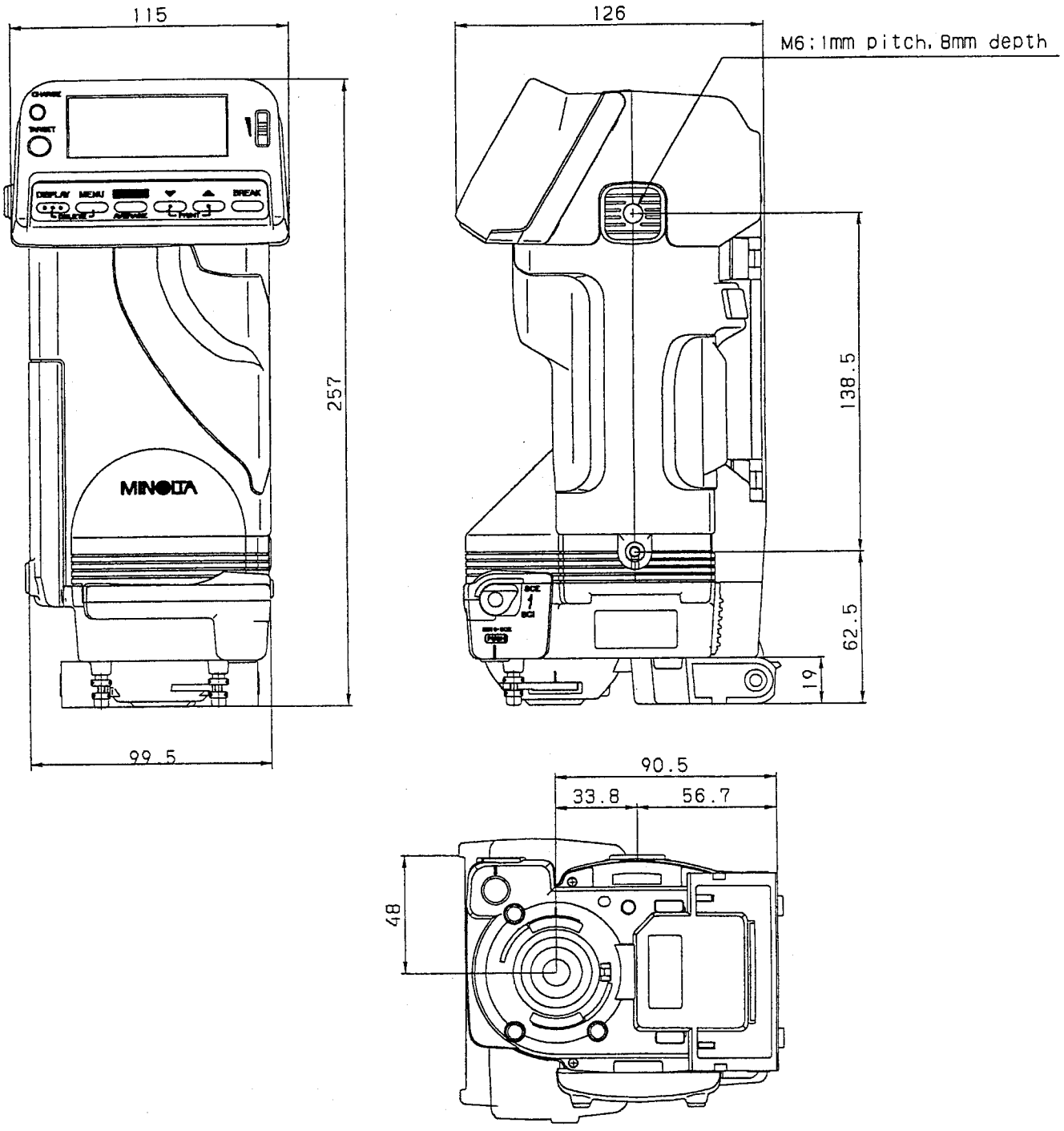
If a problem occurs with the Spectrophotometer, check the following points before requesting service. If the problem continues to occur even after the suggested corrective actions have been taken, contact the nearest Minolta authorized service facility.

- Reference page numbers: I-*xx* Page in *INTRODUCTORY MANUAL* (this booklet)
  O-*xx* Page in *OPERATION MANUAL*
  C-*xx* Page in *COMMUNICATION MANUAL*

Condition	Checkpoint	Corrective action	Refer to page
Nothing is shown in the display.	Are batteries installed correctly or is AC adapter connected correctly to both Spectrophotometer and AC wall outlet?	Install batteries correctly or connect AC adapter correctly.	O-6 O-7
	Is battery power exhausted?	Replace batteries with new ones.	O-6
	Is display contrast adjusted correctly?	Move contrast adjustment slide for easiest viewing.	O-8
Charge lamp does not light.	Are batteries installed correctly or is AC adapter connected correctly to both Spectrophotometer and AC wall outlet?	Install batteries correctly or connect AC adapter correctly.	O-6 O-7
	Is battery power exhausted?	Replace batteries with new ones.	O-6
Nothing happens when a key is pressed.	Does the key have a function in the present mode?	Press a key which has a function in the present mode.	
Nothing happens when the measuring button is pressed.	Is the Spectrophotometer in the middle of processing the previous measurement?	After a measurement has been taken, wait until the CHARGE lamp is lit before pressing the measuring button to take the next measurement.	O-28
	Is the Spectrophotometer in measuring mode?	Set Spectrophotometer to measuring mode before pressing measuring button.	O-28
	Is the measuring button selector set to **NORM.**?	Set measuring button selector to **NORM.**	I-4
Buzzer does not sound when a key is pressed.	Is BUZZER in <MENU> 3/5 set to ON?	Set BUZZER in <MENU> 3/5 to ON.	O-17
Spectrophotometer is running wild and does not respond when any of the keys are pressed.		Set POWER switch of Spectrophotometer to O (off) and then set it back to | (on).	
Spectrophotometer remains in CALIBRATION mode even after white calibration has been performed.	Was white calibration performed twice, once with the Spectrophotometer set to **SCI** and once with it set to **SCE**?	If both SCI and SCE measurements will be taken, change to the remaining SCI/SCE setting and perform white calibration measurements again. If measurements will be taken only at the present SCI/SCE setting, press **BREAK** to change to measurement mode.	O-9 O-12
Measurement values vary widely, even when measuring the same specimen.	Was the Spectrophotometer moved during measurement?	Do not move the Spectrophotometer until the measurement has been completed and results appear in the display.	O-28
FAIL appears in the display and data are highlighted even though tolerance values for the selected target color are not set.	Are the tolerance values set to 0.0?	If no tolerance checking is desired, set the tolerance values to ----.	O-43
	Is AUTO SELECT in <MENU> 3/5 set to ON?	Set AUTO SELECT in <MENU> 3/5 to OFF and select a target color for which tolerance values are not set.	O-17
The target color number changes when a measurement is taken.	Is AUTO SELECT in <MENU> 3/5 set to ON?	Set AUTO SELECT in <MENU> 3/5 to OFF.	O-17
The date and time stored with measurement data or target color data are incorrect.	Were incorrect date and time set in <MENU> 5/5?	Set the correct date and time in <MENU> 5/5.	O-19

Condition	Checkpoint	Corrective action	Refer to page
Measurement results seem strange.	Was the Spectrophotometer held correctly against the specimen surface, with the measurement aperture flat against the surface and the Spectrophotometer perpendicular to the surface?	Hold the Spectrophotometer correctly against the specimen surface.	O-20
	Is the white calibration cap still attached to the Spectrophotometer?	Remove the white calibration cap from Spectrophotometer.	I-11
	Is white calibration data correct?	Set correct white calibration data for white calibration cap used for white calibration.	O-10
	Was white calibration performed correctly?	Perform white calibration correctly.	O-12
	Was zero calibration performed correctly?	Perform zero calibration correctly.	O-13
	Is an error message related to the memory card displayed?	Install memory card correctly.	I-15
		Set write-protect switch of memory card to off position.	I-14
		Replace memory card with new one.	I-15
Strange characters (Japanese characters) appear in the display.	(Display language was changed.)	Hold **TARGET** pressed while sliding POWER switch from O (off) to | (on) to enter <LANGUAGE SELECT> mode, use **CURSOR** if necessary to move cursor to ENG., and press **BREAK**. Display language will be set back to English.	
Data input/output between the Spectrophotometer and a computer cannot be performed. Commands cannot be input to the Spectrophotometer from a computer.	Is the RS-232C cable connected correctly to both the Spectrophotometer and the computer?	Connect the RS-232C cable correctly to both the Spectrophotometer and the computer.	C-4
	Are the internal connections of the RS-232C cable correct?	The internal connections of the RS-232C cable should be the same as those in the *COMMUNICATION MANUAL*.	C-4
	Are the communication parameters set on the computer the same as those of the Spectrophotometer?	Set the communication parameters of the computer to those of the Spectrophotometer.	C-5
	Is the program correct?	Check operation using the program in the *COMMUNICATION MANUAL*.	C-24
	Is the command being input when the RTS output of the Spectrophotometer is OFF?	Input a command only when the Spectrophotometer's RTS output (the computer's CTS input) is ON.	C-6
The input command was not received correctly.	Are lower-case letters being input for the command?	Commands must be input using only upper-case letters.	C-6
		Set POWER switch of Spectrophotometer to O (off) and then set it back to | (on).	
BREAK does not function in <REMOTE> mode.		Set POWER switch of Spectrophotometer to O (off) and then set it back to | (on).	

DIMENSION DIAGRAM



SPECIFICATIONS

Model		CM-508d
Illuminating/viewing system		d/8 (diffuse illumination/8° viewing angle); SCI (specular component included)/ SCE (specular component excluded) switchable; Meets ISO 7724/1 and DIN 5033 teil 7 for d/8 geometry; also meets CIE recommendations for d/0 geometry and ASTM E1164 standards for d/0 and t/0 geometries
Detector		Silicon photodiode array with specular filter array
Wavelength range		400 to 700nm
Wavelength pitch		20nm
Half bandwidth		20nm
Photometric range		0 to 175% reflectance
Light source		Pulsed xenon arc lamp
Minimum interval between measurements		3 seconds
Battery performance		Alkaline manganese: Approx. 2000 measurements at 10-second intervals
Illumination/measurement area		Ø11mm illumination/Ø8mm measurement (Measurement aperture is Ø11mm)
Repeatability	Spectral reflectance	Standard deviation within 0.2%
	Colorimetric values	Standard deviation within ΔE^*_{ab} 0.06
	Measurement conditions	White calibration plate measured 30 times at 10-second intervals after white calibration was performed
Measurement and calculation time		2.0 seconds to display of results (except Munsell and automatic selection of target value)
Display		21-character x 7-line (128x56-dot) dot-matrix LCD with adjustable contrast
Measuring modes		Single measurement/automatic averaging of multiple measurements
Interface		RS-232C standard, 9-pin female D-subminiature connector Communication parameters: Baud rate: 1200, 2400, 4800, 9600, 19200bps Character length: 8 bits Stop bits: 1 bit Parity: NONE Manual mode: Measurement data can be output (for each measurement at time of measurement; for all selected measurements stored on memory card) REMOTE mode: Command input, data output, input of messages for display only Comment can be input using bar code reader
Display data		Spectral reflectance: Graph or numerical values Colorimetric values: Numerical absolute color and/or color difference values in the following notations: XYZ, Yxy, L*a*b*, L*C*h, Hunter Lab, Munsell, MI (Metamerism Index), CMC (ℓ:c), WI (ASTM E313), WI (CIE), YI (ASTM E313), YI (ASTM D1925), ISO Brightness (ISO 2470) ISO Status A and Status T densities Data or messages transmitted from a computer connected to the RS-232C terminal can also be displayed in REMOTE mode.
Measurement conditions		Illuminant: CIE Standard Illuminants A, C, D50, and D65; Fluorescent Illuminants F2, F6, F7, F8, F10, F11 (TL84), and F12 (Ultralume 3000) • 2 illuminants can be selected. Observer: CIE 2° and 10° Standard Observers Measurement conditions stored on installed optional memory card given priority.
Data memory		Built-in memory: Up to a total of 200 sets of data (measurement and target color) including a maximum of 199 sets of target color data With optional 128KB Memory Card CM-A46: Up to a total of 1350 sets of data including a maximum of 1349 sets of target color data With marketed 256KB PCMCIA/JEIDA-compatible SRAM card: Up to a total of 2700 sets of data including a maximum of 2699 sets of target color data

Target color data	Target color data can be set by measurement, by data input using keys, or by data input from computer connected to RS-232C terminal Target color data can be temporarily deleted and later recovered. Automatic target color selection function determines which target color is closest to measured color
Tolerance data	Upper and lower limits for color difference values in the following color spaces: XYZ, Yxy, L*a*b*, Hunter Lab, L*C*h, MI, CMC (ℓ:c), WI (ASTM E313), WI (CIE), YI (ASTM E313), YI (ASTM D1925), ISO Brightness (ISO 2470) • Upper and lower limit values can be set independently.
Other	POWER switch; CHARGE lamp; Accessory switch can be attached; Measuring button or accessory switch can be selected; displayed data can be inverted; built-in calendar/clock; built-in buzzer; automatic selection of delimiter code for data output; strap mounting socket
Power source	Dedicated AC adapter (9V, 1.2A) or 4 AA-size batteries
Dimensions (W x H x D)	115 x 257 x 126mm (4-1/2 x 10-1/8 x 5 in.)
Weight	1.3kg (2.86 lb.) including batteries
Operation temperature/humidity range	0 to 40°C (32 to 104°F); less than 85% relative humidity at 35°C (95°F) with no condensation
Storage temperature/humidity range	-20 to 55°C (-4 to 131°F); no condensation
Standard accessories	White Calibration Cap CM-A70 (with data sheet); Target Mask CM-A71; Hand Strap CM-A24; AC Adapter AC-A12; Four AA-size batteries; Hard Case CM-A62
Optional accessories	Memory Card CM-A46; Accessory Switch CM-A23; Zero Calibration Box CM-A32; Sample Holder Set (Ø8mm) CM-A48; Sample Holder Set (Ø5mm) CM-A49; Granular-Materials Cover Set CM-A40; Grip CM-A42; Measuring Stand CM-A30; RS-232C Cable IF-A11 through IF-A15; Bar Code Reader Adapter Cable CM-A72; Transmittance Adapter CM-A76

INDEX

The following is a comprehensive index to all three manuals included with the Spectrophotometer.
Page numbers: I-*xx* Page in *INTRODUCTORY MANUAL* (this booklet)
O-*xx* Page in *OPERATION MANUAL*
C-*xx* Page in *COMMUNICATION MANUAL*

9222-1858-32

ICLAP① Printed in Japan