Hitachi High-Tech
HITACHI

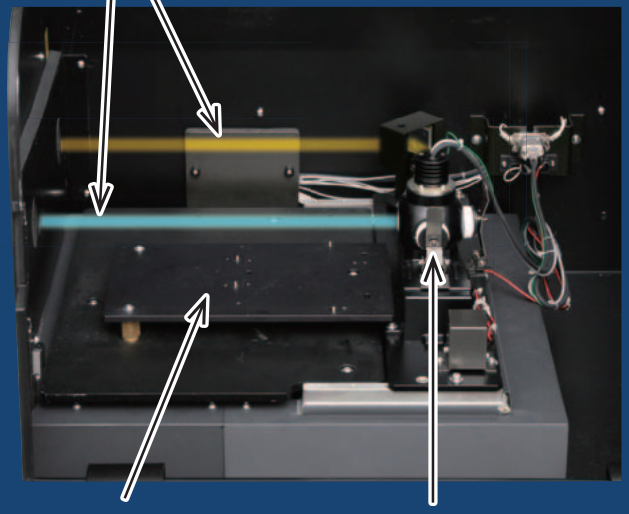
# Hitachi UV-VIS-NIR Spectrophotometer
# Accessories Catalog

UH4150
&
U-4100
Accessories

# Customize a System to Fit Your Applications

Models U-4100 and UH4150 allow custom configurations to meet a variety of measuring needs by combining accessories appropriate to the objectives of the application. Models U-4100 and UH4150 offer highly-accurate testing, which make them the most appropriate tool for a variety of fields, including optical materials and components, semiconductors, new material development, and biotechnology.

Collimated light beam enabling more accurate measurements



Large sample compartment allows using a wide variety of accessories

Detectors (integrating spheres) can be selected according to measurement needs

**View of Sample Compartment of UH4150***

* Image above does not represent actual beams.

Dozens of accessories are available to meet the objectives of the measurement

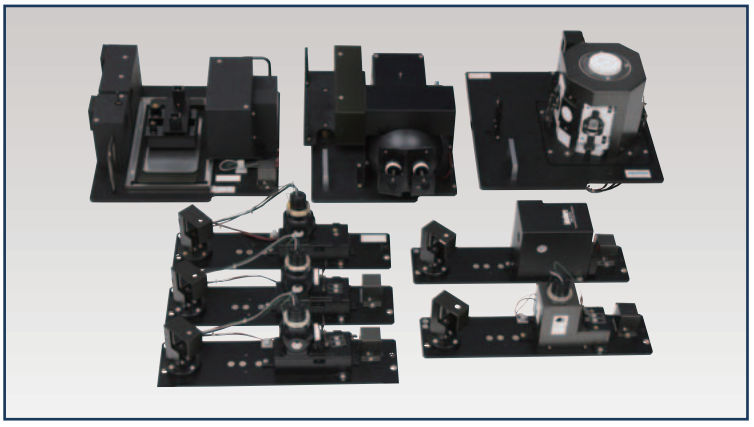
**Lineup of Accessories**

Model UH4150 Spectrophotometer


Model U-4100 Spectrophotometer

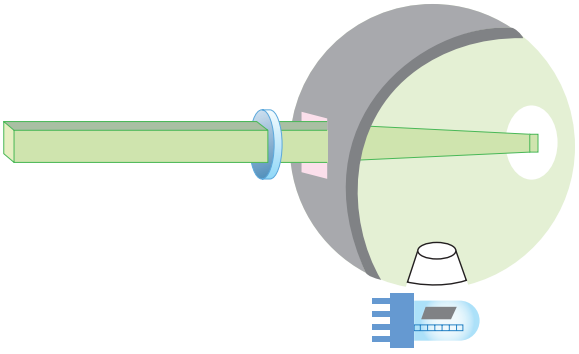
# Detector Selection Guide

A variety of integrating sphere detectors are offered for Model UH4150, allowing the selection of a detector suitable for the measurement. Below is information on how to select an appropriate integrating sphere.

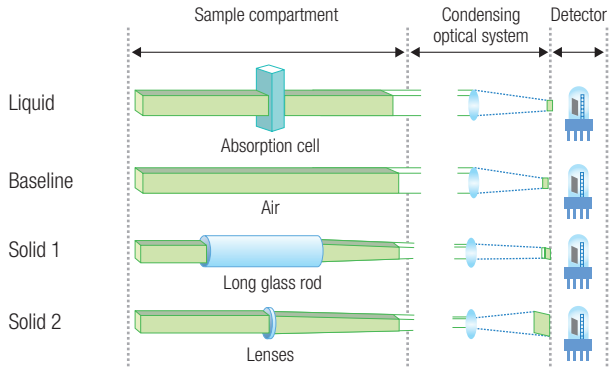


## 1. Direct Light Detection and Integrating Sphere Detection

Direct light detection is suitable for absorbance measurement of liquid samples and for transmittance measurement of non-diffusive flat plates. However, for long rod-shaped samples, lenses, and diffusive samples, the shape of transmitted light beam is affected by refraction and scattering. If the size of the light beam for sample measurement is different from that for baseline measurement, accurate results cannot be obtained due to the effect of locality of the detector. In such cases, the effect of locality of the detector can be removed by allowing the incident light to undergo diffuse reflection in the interior of the integrating sphere, and then by guiding it to the detector.



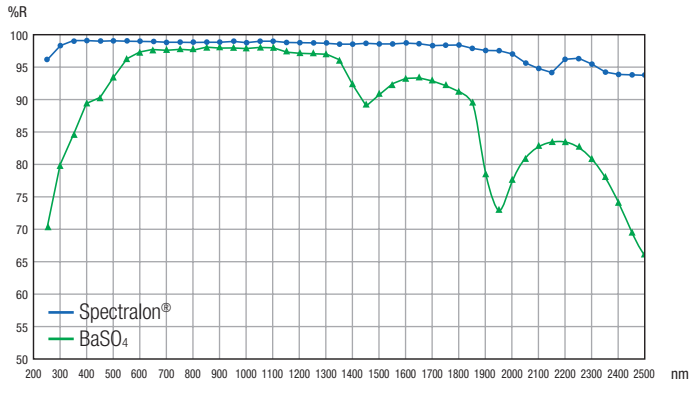
Schematic Diagram of Integrating Sphere Detection System




Schematic Diagram of Direct Light Detection

## 2. Coating Materials for Integrating Spheres

For general integrating spheres, barium sulfate ($BaSO_4$) is used as the internal coating material, and aluminum oxide ($Al_2O_3$) is used for the standard reflection plates. Spectralon® is a fluoropolymer that has the highest diffuse reflectance of any known material over the ultraviolet, visible, and near-infrared regions of the spectrum, as illustrated in the figure in which Spectralon® is compared with $BaSO_4$. Because of low loss in light intensity, Spectralon®-coated integrating spheres allow higher sensitivity measurements.




Reflectance Characteristics of coating materials for Integrating Sphere

| | Material | Wavelength Range |
|---|---|---|
| 60 mm Standard Integrating Sphere | $BaSO_4$ | 240 - 2,600 nm |
| 60 mm High-sensitivity Integrating Sphere | Spectralon® | 190 - 2,600 nm |

## 3. 60 mm and 150 mm Integrating Spheres

Hitachi spectrophotometer accessories include 60 mm integrating spheres (opening ratio : about 7.8%) and 150 mm integrating spheres (opening ratio : about 2%). Generally, 60 mm integrating spheres are used due to its versatility as well as its superior baseline flatness and noise level.

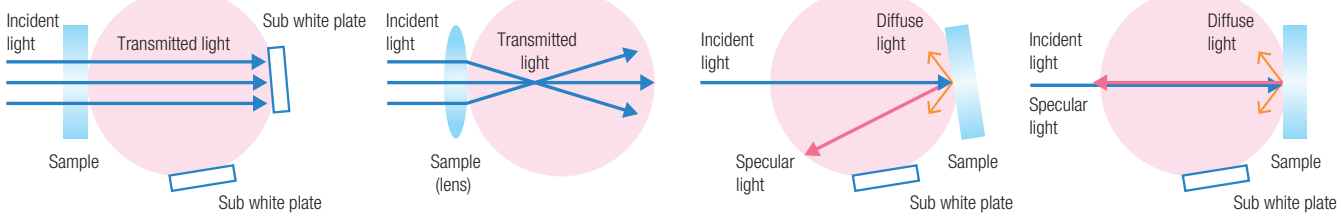
However, for total or diffuse reflectance measurement of samples having high diffusivity, 150 mm integrating spheres, which have a smaller opening ratio, provide higher photometric accuracy. The reason is because the port fraction is smaller, reducing the probability of leakage of sample reflected light, through the port.

| | 60 mm Integrating Sphere | 150 mm Integrating sphere |
|---|---|---|
| Appearance |  |  |
| Diameter | 60 mm | 150 mm |
| Opening ratio | About 7.8% | About 2.0% |
| Applications | Measurement using the integrating sphere combined with a variety of accessories | Reflectance or Transmittance measurement of samples having a high diffusivity |
| | Low noise measurement | Highly accuracy color analysis |
| | Specular reflectance measurement | |

## 4. Number of Ports and Port inclination for 60 mm Integrating Sphere

An integrating sphere has light receiving ports. The number of ports and their angle of inclination are selected depending on the measurement objective. For usual transmittance measurement, almost any type of integrating sphere can be used. However, in the case of lenses and thick sample measurements, where the transmitted light diverges, if a four-port integrating sphere is used, incident light beam would overflow from the sub white plate; measurement errors might arise due to the difference in the reflectance characteristics between the inner surface material of integrating sphere and the material of the sub white plate. In the case of a two-port full integrating sphere, such measurement errors will not occur.

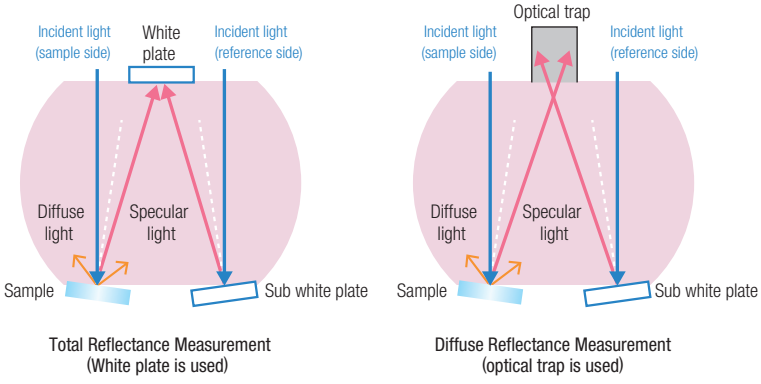
For a total reflectance measurement, the sample is placed behind the integrating sphere. By using the port inclination angle of 8° or 10° in the rear port, the integrating sphere measures total reflectance of the sample, including specular reflectance. On the other hand, for diffuse reflectance measurements, an inclination angle of 0° for the rear port is used. Then, the sample's specular reflectance is emitted through the light incident port, and only the sample diffuse reflectance is measured by the integrating sphere.




| | Usual Transmittance Measurement | Transmittance Measurement of Lens | Total Reflectance Measurement | Diffuse Reflectance Measurement |
|---|---|---|---|---|
| Number of ports | 2 or 4 | 2 (full-sphere type) | 4 | 4 |
| Port inclination angle | — | — | 8° or 10° | 0° |

## 5. Reflectance Measurements using a 150 mm Integrating Sphere (Total and Diffuse Reflectance)

The 150 mm Integrating Sphere Accessory allows both total and diffuse reflectance measurements. For total reflectance, a white plate is placed at the position opposite from the integrating sphere, where the sample's specular light can be measured, to detect the sample's total reflected light including both specular light and diffuse light. On the other hand, for diffuse reflectance measurement, an optical trap is placed at the position opposite from the integrating sphere, where sample specular light can be measured, allowing sample specular light to leave so that only sample diffuse light is measured. Since a 150 mm integrating sphere is larger than a 60 mm integrating sphere and allows for removing specular light using optical trap, the 150 mm integrating spheres allow highly accurate diffuse reflectance measurements.




Optical System of the 150 mm Standard Integrating Sphere

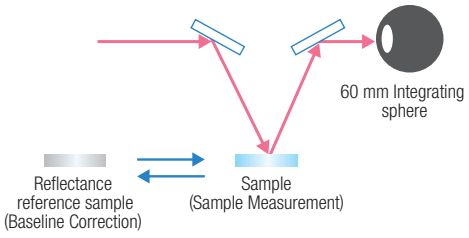
# Reflectance Measurement Guide

Optical characteristics measurement of solid samples includes reflectance measurement. An example of reflectance measurement is shown below.

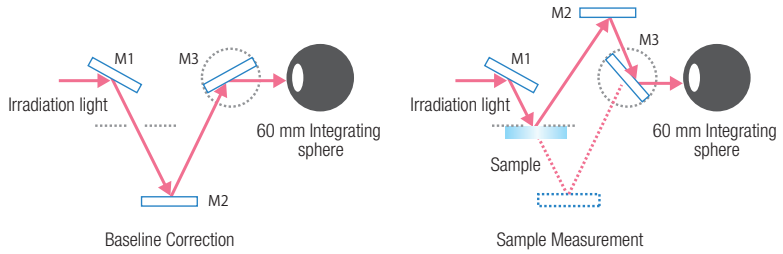
## 1. Relative and Absolute Reflectance Measurements

There are two types of specular reflectance measurements : Relative and Absolute. In Relative Reflectance Measurements, a reflectance reference sample is placed in the light beam path for baseline correction. Then, the reflectance reference sample is replaced by the sample for measuring the sample reflectance. In this way, the sample's reflectance relative to the reflectance of the reference sample, which is assumed 100%, is obtained. The relative reflectance measurement is useful for quality control against a reference sample.

The absolute specular reflectance measurement is performed by using the V-N method. For baseline correction, the light is guided through a V-shaped path consisting of mirrors M1, M2, and M3, to the detector. For the sample measurement, the light is guided through an N-shaped path consisting of M1, a sample, M2, and M3 (where the sample is placed between M1 and M2, the position of M2 is changed, and the angle of M3 is changed to keep the length of the light beam to the detector unchanged). The only difference between baseline measurement and sample measurement is that the sample 's reflective surface is included in the light beam path, but other reflective surfaces and the length of the light beam path are unchanged. In this method, the absolute reflectance measurement is accomplished by comparing the detector outputs between baseline measurement and sample measurement.

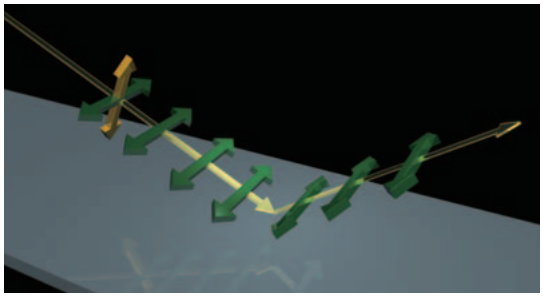



Relative Reflectance Measurement

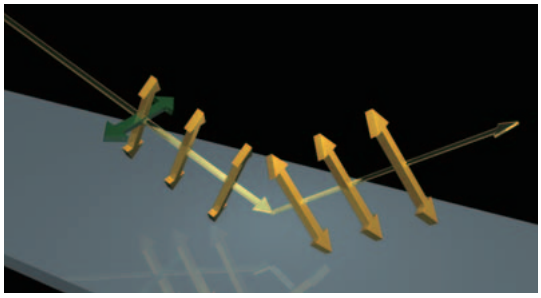



Absolute Reflectance Measurement

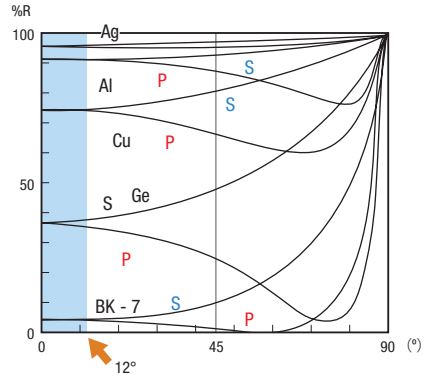
## 2. Dependence of Incident Angle and Reflectance on Polarization of Light



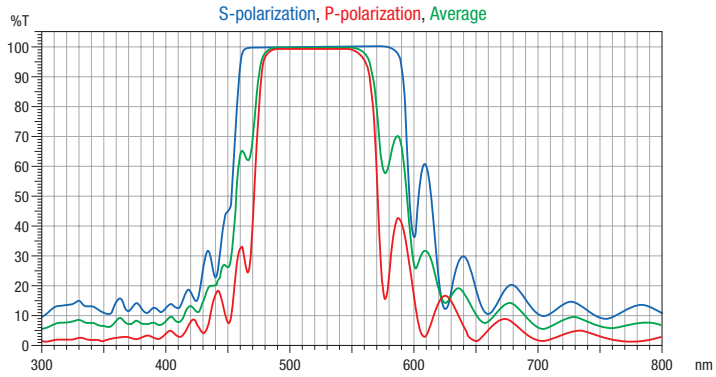
Reflection of S-polarized light



Reflection of P-polarized light




Dependence of Absolute Reflectance of S-polarization and P-polarization on Incident Angle




45˚ Specular Reflectance Spectrum of S-polarization and P-polarization of Dielectric Multilayer Film

For incident angles larger than 12˚, the difference in reflectance between S and P-polarization is considerable. Moreover, the light intensity of irradiation light of the spectrophotometer varies between S and P-polarization depending on the wavelength. Therefore, to obtain the absolute reflectance of a sample, a polarizer is used for measuring the reflectance of S and P-polarization, respectively, and the two values of reflectance are averaged.

Shown above is a 45˚ specular reflectance spectrum of S and P-polarization of a dielectric multilayer film. The reflectance spectrum profile is different for S and P-polarization. The reflectance of the sample is given as the average of values of reflectance of S and P-polarization.

# Models UH4150 and U-4100, the experts in solid state spectrophotometry, allow configuring a system to meet a variety of measurement needs by combining accessories appropriate to the application objectives.

## Lineup of Detectors (Integrating Spheres)

### 60 mm Standard Integrating Sphere (for both total reflectance and diffuse reflectance) P.7

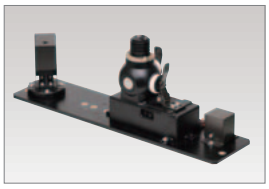
UH4150 : P/N 1J1-0120, U-4100 : P/N 1J0-0216*

Internal coating material : $BaSO_4$, Sub white plate: $Al_2O_3$, Number of ports : 4, Port inclination angle : Sample side; 8˚, reference side; 0˚

Measurement: Transmittance, Absorbance, Scattered Light, Total Reflectance, Diffuse Reflectance, Specular Reflectance

Wavelength Region: Far UV, Near UV, Visible, Near Infrared

| Specifications | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Baseline flatness | ±0.002 Abs (240 - 2,200 nm)<br>±0.004 Abs (2,200 - 2,600 nm) |



60 mm Standard Integrating Sphere
(for both total reflectance and diffuse reflectance)

A standard integrating sphere of all-round type applicable to diverse measurement applications

### 60 mm Standard Integrating Sphere (for total reflectance) P.7

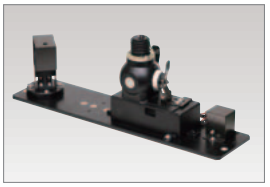
UH4150 : P/N 1J1-0121, U-4100 : P/N 134-0218

Internal coating material : $BaSO_4$, Sub white plate: $Al_2O_3$, Number of ports : 4, Port inclination angle : Sample side; 10˚, reference side; 10˚

Measurement: Transmittance, Absorbance, Scattered Light, Total Reflectance, Diffuse Reflectance, Specular Reflectance

Wavelength Region: Far UV, Near UV, Visible, Near Infrared

| Specifications | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Baseline flatness | ±0.002 Abs (240 - 2,200 nm)<br>±0.004 Abs (2,200 - 2,600 nm) |



60 mm Standard Integrating Sphere
(for total reflectance)

An orthodox integrating sphere equipped standard on the model U-4100 (solid sample and large sample compartment types)

### 60 mm Standard Full Integrating Sphere P.11

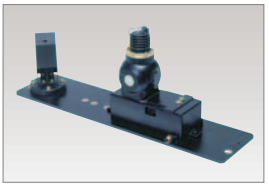
UH4150 : P/N 1J1-0122, U-4100 : P/N 134-0205

Internal coating material : $BaSO_4$, Sub white plate : none, Number of ports : 2

Measurement: Transmittance, Absorbance, Scattered Light, Total Reflectance, Diffuse Reflectance, Specular Reflectance

Wavelength Region: Far UV, Near UV, Visible, Near Infrared

| Specifications | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Baseline flatness | ±0.002 Abs (240 - 2,200 nm)<br>±0.004 Abs (2,200 - 2,600 nm) |



60 mm Standard Full Integrating Sphere

A full-sphere integrating sphere applicable to lenses and samples having a high diffusivity

### 60 mm High-sensitivity Integrating Sphere (for reflectance measurement) P.15

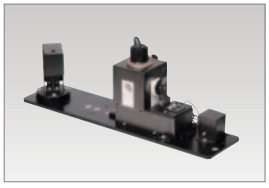
UH4150 : P/N 1J1-0123, U-4100 : P/N 1J0-0210

Internal coating material: Spectralon®, Sub white plate : Spectralon®, Number of ports: 4, Port-inclination angle : Sample side; 8˚, reference side; 0˚

Measurement: Transmittance, Absorbance, Scattered Light, Total Reflectance, Diffuse Reflectance, Specular Reflectance

Wavelength Region: Far UV, Near UV, Visible, Near Infrared

| Specifications | |
|---|---|
| Wavelength range | 190 - 2,600 nm |
| Baseline flatness | ±0.5%T (195 - 2,600 nm)<br>±2.0%T (190 - 195 nm) |



60 mm High-sensitivity Integrating Sphere
for Reflectance Measurement

A low-noise integrating sphere applicable to diverse measurement applications including those in far UV region

### 60 mm High-sensitivity Full Integrating Sphere P.19

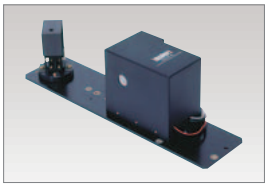
UH4150 : P/N 1J1-0124, U-4100 : P/N 134-0206

Internal coating material : Spectralon®, Sub white plate : none, Number of ports : 2

Measurement: Transmittance, Absorbance, Scattered Light, Total Reflectance, Diffuse Reflectance, Specular Reflectance

Wavelength Region: Far UV, Near UV, Visible, Near Infrared

| Specifications | |
|---|---|
| Wavelength range | 190 - 2,600 nm |
| Baseline flatness | ±0.5%T (195 - 2,600 nm)<br>±2.0%T (190 - 195 nm) |



60 mm High-sensitivity Full Integrating Sphere

A low-noise integrating sphere applicable to lenses and samples having high diffusivity, including applications measurement in the far UV region

## 150 mm Standard Integrating Sphere with Optical Trap P.23

### UH4150, U-4100 : P/N 1J0-0212

Internal coating material : $BaSO_4$, Sub white plate : $Al_2O_3$, Number of ports : 5, Port-inclination angle : Sample side; 6°, reference side; 6°

**Measurement**

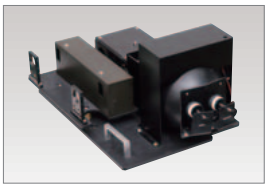
| | | |
|---|---|---|
| Transmittance | Absorbance | Scattered Light |
| Total Reflectance | Diffuse Reflectance | Specular Reflectance |

**Wavelength Region**

| | |
|---|---|
| Far UV | Near UV |
| Visible | Near Infrared |

**Specifications**

| | |
|---|---|
| Wavelength range | 350 - 750 nm |
| Baseline flatness | ±0.5%T |



150 mm Standard Integrating Sphere

A large-size integrating sphere with a small opening ratio, suitable for accurate measurement of samples having high diffusivity

## 150 mm High-sensitivity Integrating Sphere with Optical Trap P.23

### UH4150 : P/N 1J1-0126*, U-4100 : P/N 1J0-0376*

Internal coating material : Spectralon®, Sub white plate : Spectralon®, Number of ports : 5, Port-inclination angle : Sample side; 8°, reference side; 8°

**Measurement**

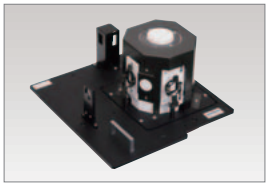
| | | |
|---|---|---|
| Transmittance | Absorbance | Scattered Light |
| Total Reflectance | Diffuse Reflectance | Specular Reflectance |

**Wavelength Region**

| | |
|---|---|
| Far UV | Near UV |
| Visible | Near Infrared |

**Specifications**

| | |
|---|---|
| Wavelength range | 240 - 2,500 nm |
| Baseline flatness | ±0.002 Abs (240 - 2,200 nm)<br>±0.004 Abs (2,200 - 2,500 nm) |



150 mm High-sensitivity Integrating Sphere

A large-size integrating sphere with a small opening ratio, suitable for accurate measurement of samples having high diffusivity, including measurement applications in near infrared region

## Continuously Variable Angle Absolute Reflectance Accessory P.23

### UH4150 : Standard-sample version (P/N 1J1-0131) , Micro-sample version (P/N 1J1-0132)
### U-4100 : Standard-sample version (P/N 134-0115) , Micro-sample version (P/N 1J0-0206)

Internal coating material : $BaSO_4$, Sub white plate : none, Number of ports : 2

**Measurement**

| | | |
|---|---|---|
| Transmittance | Absorbance | Scattered Light |
| Total Reflectance | Diffuse Reflectance | Specular Reflectance |

**Wavelength Region**

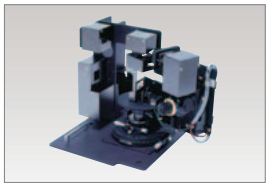
| | |
|---|---|
| Far UV | Near UV |
| Visible | Near Infrared |

**Specifications (Standard-sample version)**

| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | Flat substrate : 30 × 30 - 90 × 90 mm<br>Prism : cube of 85 mm or less |
| Wavelength range | 240 - 2,000 nm |

**Specifications (Micro-sample version)**

| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 3.5 × 3.5 - 90 × 90 mm |
| Sample thickness | 3 mm or less (Sample size : 3.5 - 26 mm)<br>5 mm or less (Sample size : 26 - 90 mm) |
| Wavelength range | 340 - 2,000 nm |



Continuously Variable Absolute Reflectance Accessory

An accessory equipped with an integrating sphere, applicable to measurements of transmittance and specular reflectance using any desired angle from 20° to 60°

## Selecting a detector for the UH4150 main unit

- **UH4150 Integrating Sphere Detection System**
  A 60 mm integrating sphere needs to be purchased with the spectrophotometer to use for calibration and performance check.
- **UH4150 Direct Light Detection System**
  The direct light detector built in the spectrophotometer, is used for calibration and performance check.
  The direct light detector can be replaced with an optional integrating sphere detector.

Rough division of spectral regions (nm)

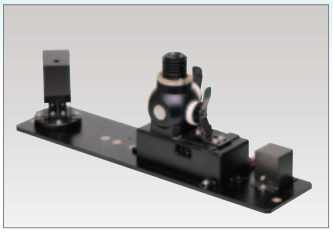
| Far UV | Near UV | Visible | Near Infrared |
|---|---|---|---|
| 190 - 240 nm | 240 - 380 nm | 380 - 780 nm | 780 - 2,600 nm |

* Produced on order item.

# 60 mm Standard Integrating Sphere

## UH4150 : Total reflectance P/N 1J1-0121, both Total and Diffuse reflectance P/N 1J1-0120
## U-4100 : Total reflectance P/N 134-0218, both Total and Diffuse reflectance P/N 134-0216*

There are two types of these highly versatile integrating spheres: one for total reflectance measurement, in which the rear port inclination angles are 10° for sample side and 10° for reference side and the other for both total reflectance and diffuse reflectance, in which the rear port inclination angles are 8° for sample side and 0° for reference side. With the 60 mm Standard Integrating Sphere, the following accessories are available for the respective measurement applications.


60 mm Standard Integrating Sphere

* Produced on order item.

## Accessories for Transmittance and Absorbance Measurements

◆ Sample size : Standard

Samples of glass, film, thin film, etc.

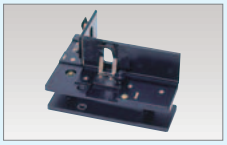
Incident angle: 0° → Diffusivity : No

### Glass Filter Holder (P/N 134-0207)

Used for transmittance and absorbance measurement of plate solid samples, such as glass filter

Specifications

| | |
|---|---|
| Sample thickness | 0.5 - 5 mm |
| Sample size | 12 × 12 - 55 × 100 mm |

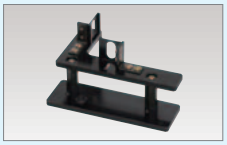

Glass Filter Holder

### Film Holder (P/N 134-0208)

Used for transmittance and absorbance measurement of thin film samples

Specifications

| | |
|---|---|
| Film frame | 25 mm wide, 30 - 55 mm high |
| Light beam opening | 10 mm wide, 20 mm high |


Film Holder

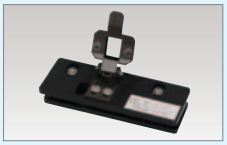
Diffusivity : Yes

### Transmittance Holder (close contact) (P/N 1J0-0202)

Used for transmittance and absorbance measurement of diffusive solid samples

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |


Transmittance Holder (close contact)

Incident angle : 0°- 60°

### Variable Angle Transmittance Accessory (P/N 134-0200)
### Polarizer Holder (P/N 132-0325) *1

A rotation stage is used for transmittance measurement under a desired incident angle from 0° to 60°. A polarizer and a polarizer holder are also used to remove the effect of polarization characteristics.

Specifications

| | |
|---|---|
| Incident angle | 0 - 60° |
| Light beam size | About 12.3 (H) × 8.5 (W) mm |
| Wavelength range | 240 - 2,600 nm |
| Sample size | 40 × 40 - 140 × 140 mm, thickness of 3 mm or less |


Variable Angle Transmittance Accessory

### (Option) Sample holder for P/N 134-0200 (P/N 134-6000)

Specifications

| | |
|---|---|
| Sample size | 25 × 25 - 50 × 50 mm, thickness of 3 mm or less |

*1 A Glan-Taylor polarizer is required.

Polarizing plate, etc.

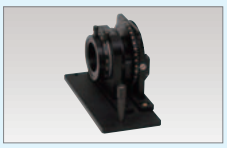
Incident angle : 0° → Diffusivity : No

### Polarizing plate Measurement Accessory (P/N 1J0-0208)

Used for the measurement of polarization characteristics by rotating two polarizing plates in the cross arrangement and the parallel arrangement. A polarizer and a polarizer holder (P/N 132-0325), or a depolarizer (P/N 134-6156) is needed separately.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |


Polarizing Sample Measurement Accessory

## Accessories for Transmittance and Absorbance Measurements

Liquid samples → Incident angle : 0°

### 10 mm Rectangular Cell Holder (P/N 134-0209)

10 mm Rectangular Cell Holder is used for measuring transmittance and absorbance of liquid samples. This holder is also required when using a filter calibration standard.

10 mm Rectangular Cell Holder

◆Sample size : Small

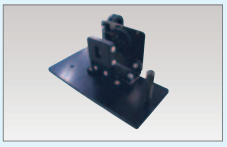
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No

### Transmittance Measurement Accessory for Micro Samples (P/N 1J0-0204)

Used for measurement of micro samples of ø20 mm or less.
It includes a mask*2 that narrows down the light beam and a holder for the Micro sample.

Specifications

| | |
|---|---|
| Mask Type | Applicable Sample Size |
| ø3 mm Mask (supplied standard) | ø5 - ø20 mm, thickness 3 mm or less |
| ø1 mm Mask (supplied separately) | ø3 - ø20 mm, thickness 3 mm or less |



Transmittance Measurement accessory for Micro Samples

Micro Sample Holder (supplied standard)

*2 It is necessary to replace the standard light source mask with the supplied ø4 mm light source mask.

◆Sample size : Large

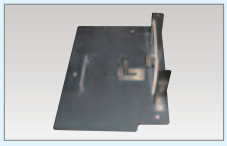
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No

### Transmittance Holder for Large Sample (P/N 1J0-0214)

A transmittance holder for samples of large size of 300 × 300 mm

Specifications

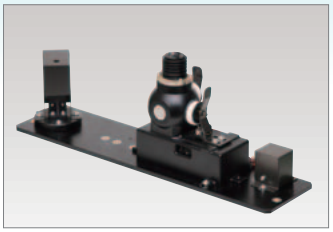
| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 50 × 50 - 300 × 300 mm |



Transmittance Holder for Large Sample

# 60 mm Standard Integrating Sphere

## UH4150 : Total reflectance P/N 1J1-0121, both Total and Diffuse reflectance P/N 1J1-0120
## U-4100 : Total reflectance P/N 134-0218, both Total and Diffuse reflectance P/N 1J0-0216*



60 mm Standard Integrating Sphere

* Produced on order item.

## Accessories for Reflectance Measurements

◆Sample size : Standard

Samples of glass, film, thin film, powder, resin plate, etc.

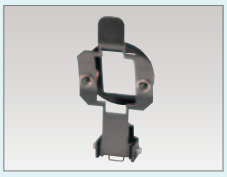
Total reflectance, diffuse reflectance*3

- Opaque → Possible to measure without any accessory
- Transparent → White Plate Holder with Transmission Hole (P/N 130-2179)

Used for total reflectance measurement of transparent samples (glasses etc.). It is constructed to prevent transmitted light from entering into the integrating sphere.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 50 × 50 - 300 × 300 mm |



White Plate Holder with Transmission Hole

*3 Diffuse reflectance measurement is possible by the use of a 60 mm Standard Integrating Sphere for both Total and Diffuse reflectance (P/N 1J1-0121 for UH4150, P/N 134-0218 for U-4100).

Samples of glass, film, thin film, etc.

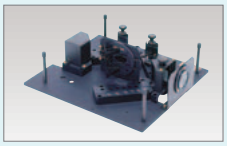
Specular reflectance (absolute)

- Incident angle : Variable (in increments of 10°) → Variable Angle Absolute Reflectance Accessory (10° - 60°) (P/N 134-0116); Variable Angle Absolute Reflectance Accessory (15° - 65°) (P/N 134-0117)

Absolute reflectance of a sample is measured by the V-N method with the mirror relocated to the specified position. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

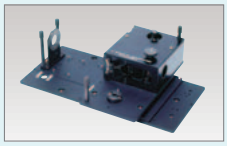
Common specifications

| | |
|---|---|
| Sample thickness | P/N 134-0116 : 10° - 60° (in increments of 10°)<br>P/N 134-0117 : 15° - 65° (in increments of 10°) |
| Sample size | 8 × 8 - 90 × 100 mm |
| Wavelength range | 240 - 2,600 nm |

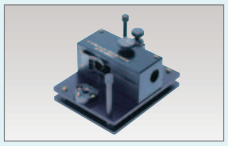


Variable Angle Absolute Reflectance Accessory

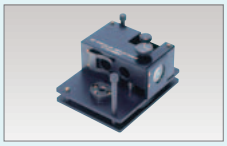
- Incident angle : Continuously variable → Use the Continuously Variable Angle Absolute Reflectance Accessory. Please see page 23 for details.
- Incident angle : Fixed → 5° Specular Reflectance Accessory (Absolute) (P/N 134-0102); 12° Specular Reflectance Accessory (Absolute) (P/N 134-0104); 30° Specular Reflectance Accessory (Absolute) (P/N 134-0105) Polarizer Holder*1 (P/N 132-0325); 45° Specular Reflectance Accessory (Absolute) (P/N 134-0106) Polarizer Holder*1 (P/N 132-0325)



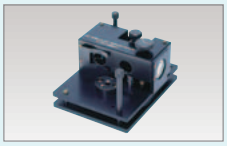
5° Specular Reflectance Accessory (Absolute)



12° Specular Reflectance Accessory (Absolute)



30° Specular Reflectance Accessory (Absolute)



45° Specular Reflectance Accessory (Absolute)

Used for measurement of reflective characteristics of metal films or glass surfaces depending on incident angle by measuring absolute reflectance using the V-N method. Transmittance measurement under the conditions of the same point and the same incident angle is also possible. In the case of the 30° and 45° Specular Reflectance Accessory, using a polarizer is required. (Some samples may require a polarizer even for 5° and 12° accessories.) Please see Reflectance Measurement Guide on page 4 for details. Samples are placed on the side of the accessory.

*1 A Glan-Taylor polarizer is required.

Common specifications

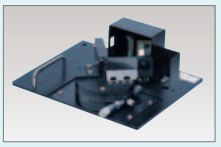
| | |
|---|---|
| Sample size | Absolute reflectance measurement;<br>25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |

Samples of glass, film, thin film, etc.

Specular reflectance (relative reflectance) → Incident angle : Variable → **Variable Angle Reflectance Accessory (Relative) (P/N 134-0118)**

Specifications

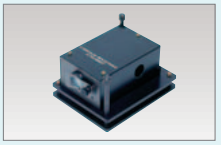
| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 25 × 25 - 50 × 100 mm |
| Wavelength range | 240 - 2,600 nm |


Variable Angle Reflectance Accessory (Relative)

Incident angle : Fixed → **5° Specular Reflectance Accessory (Relative) (P/N 134-0100)**

Specifications

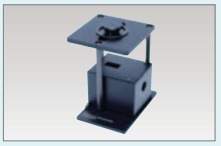
| | |
|---|---|
| Sample size | Relative reflectance measurement : 25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |


5° Specular Reflectance Accessory (Relative)

**Vertical 5° Specular Reflectance Accessory (Relative) (P/N 134-0101)**

Specifications

| | |
|---|---|
| Sample size | ø25 - ø100 mm |
| Wavelength range | 240 - 2,600 nm |

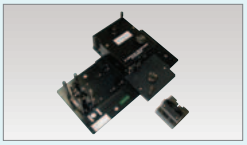

Vertical 5° Specular Reflectance Accessory (Relative)

The specular reflection of a reference sample is used to measure the sample reflectance relative to the reference.

◆Sample size : Small

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance → **Specially supplied to order**

Samples of glass, film, thin film, etc. → Specular reflectance (absolute) → Incident angle : Fixed → **Small 5° Specular Reflectance Accessory (Absolute) (P/N 134-0103)**


Small 5° Specular Reflectance Accessory (Absolute)

Specifications

| | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Incident angle | 5° ± 1° |
| Measurement method | Absolute reflectance and Relative reflectance |
| Light beam size | About 2.2 (W) × 2.2 (H) mm |
| Sample mounting unit | ø20 mm |
| Sample size | See the table to the right |

| Applicable sample size | |
|---|---|
| Standard measurement | ø25 - ø50 mm, 25 - 150 (W) × 25 - 100 (H) mm |
| Use of Micro Sample Holder (Supplied standard) | ø7 - ø17 mm, 5 × 5 - 12 × 12 mm |

The following accessory holders are separately supplied for much smaller samples.

Specifications

| | |
|---|---|
| Micro Sample Holder 2 (P/N 132-7401) | Measurement area : ø2 mm<br>Sample size : ø3 - ø18 mm<br>12 mm square or less |
| Micro Sample Holder 4 (P/N 132-7403) | Measurement area : ø4 mm<br>Sample size : ø5 - ø18 mm<br>12 mm square or less |


Micro Sample Holder (supplied standard)

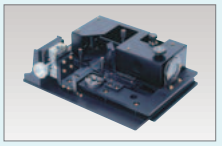
◆Accessories for specific types of samples

Prism → Specular reflectance and transmittance (incident angle of 45°)

- Sample size : Standard → **Prism Measurement Unit (P/N 134-0110)**

Specifications

| | |
|---|---|
| Incident angle | 45° |
| Sample size | 16 - 60 mm cube |
| Measuring point | Center |
| Wavelength range | 240 - 2,600 nm |

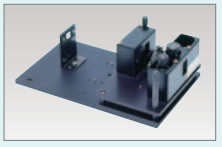

Prism Measurement Unit

- Sample size : Small → **Small Prism Measurement Unit (P/N 134-0111)**

Used for the measurement of transmittance and reflectance of various prisms at the incident angle of 45°. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Specifications

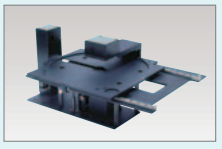
| | |
|---|---|
| Incident angle | 45° |
| Sample size | 5 - 6 mm square-cube<br>7 - 20 mm square-cube |
| Wavelength range | 240 - 2,600 nm |


Small Prism Measurement Unit

*1 A Glan-Taylor polarizer is required.

Wafer

- Specular reflectance and transmittance (incident angle of 5°, relative reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0107)**
- Specular reflectance and transmittance (incident angle of 12°, absolute reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0108)**


Top-mount Transmittance and Reflectance Measurement Unit

Common Specifications

| | |
|---|---|
| Incident angle | P/N 134-0107 : Transmittance; 0°, Reflectance; 5° (relative)<br>P/N 134-0108 : Transmittance; 0°, Reflectance; 12° (absolute) |
| Sample size | 50 × 50 - 230 × 230 mm, ø6 inch, ø8 inch |
| Wavelength range | 240 - 2,600 nm |

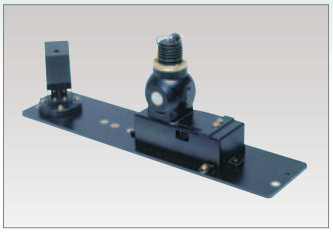
Measurement of transmittance and reflectance of large-size samples is possible by switching the light beam path.

Other sample holders for photomask, etc. are also available.

# 60 mm Standard Full Integrating Sphere

## UH4150 : P/N 1J1-0122, U-4100 : P/N 134-0205

This type of integrating sphere has no rear ports, and is suitable for measurement of lenses and other samples, where transmitted light beam changes in shape. However, total and diffuse reflectance measurement is not available. With the 60 mm Standard Full Integrating Sphere, the following accessories can be used for respective measurement applications.



60 mm Standard Full Integrating Sphere

## Accessories for Transmittance and Absorbance Measurements

◆Sample size : Standard

Samples of glass, film, thin film, etc.

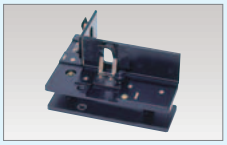
### Incident angle : 0° → Diffusivity : No

#### Glass Filter Holder (P/N 134-0207)

Used for transmittance and absorbance measurement of plate solid samples, such as glass filter

Specifications

| | |
|---|---|
| Sample thickness | 0.5 - 5 mm |
| Sample size | 12 × 12 - 55 × 100 mm |



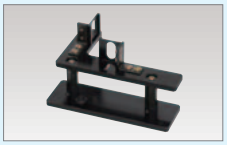
Glass Filter Holder

#### Film Holder (P/N 134-0208)

Used for transmittance and absorbance measurement of thin film samples

Specifications

| | |
|---|---|
| Film frame | 25 mm wide, 30 - 55 mm high |
| Light beam opening | 10 mm wide, 20 mm high |



Film Holder

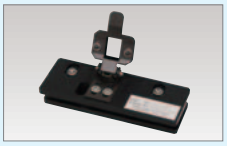
### Diffusivity : Yes

#### Transmittance Holder (close contact) (P/N 1J0-0202)

Used for transmittance and absorbance measurement of diffusive solid samples

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Transmittance Holder (close contact)

### Incident angle : 0°- 60°

#### Variable Angle Transmittance Accessory (P/N 134-0200)
#### Polarizer Holder (P/N 132-0325) *1

A rotation stage is used for transmittance measurement under a desired incident angle from 0° to 60°. A polarizer and a polarizer holder are also used to remove the effect of polarization characteristics.

Specifications

| | |
|---|---|
| Incident angle | 0 - 60° |
| Light beam size | About 12.3 (H) × 8.5 (W) mm |
| Wavelength range | 240 - 2,600 nm |
| Sample size | 40 × 40 - 140 × 140 mm, thickness of 3 mm or less |

Variable Angle Transmittance Accessory

#### (Option) Sample holder for P/N 134-0200 (P/N 134-6000)

Specifications

| | |
|---|---|
| Sample size | 25 × 25 - 50 × 50 mm, thickness of 3 mm or less |

*1 A Glan-Taylor polarizer is required.

Polarizing plate, etc.

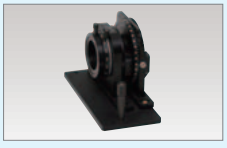
### Incident angle : 0° → Diffusivity : No

#### Polarizing plate Measurement Accessory (P/N 1J0-0208)

Used for the measurement of polarization characteristics by rotating two polarizing plates in the cross arrangement and the parallel arrangement. A polarizer and a polarizer holder (P/N 132-0325), or a depolarizer (P/N 134-6156) is needed separately.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Polarizing Sample Measurement Accessory

## Accessories for Transmittance and Absorbance Measurements

Liquid samples → Incident angle : 0°

### 10 mm Rectangular Cell Holder (P/N 134-0209)

10 mm Rectangular Cell Holder is used for measuring transmittance and absorbance of liquid samples. This holder is also required when using a filter calibration standard.

10 mm Rectangular Cell Holder

◆Sample size : Small

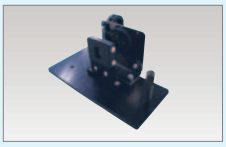
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No

### Transmittance Measurement Accessory for Micro Samples (P/N 1J0-0204)

Used for measurement of micro samples of ø20 mm or less.
It includes a mask*2 that narrows down the light beam and a holder for the Micro sample.

Specifications

| Mask Type | Applicable Sample Size |
|---|---|
| ø3 mm Mask (supplied standard) | ø5 - ø20 mm, thickness 3 mm or less |
| ø1 mm Mask (supplied separately) | ø3 - ø20 mm, thickness 3 mm or less |



Transmittance Measurement accessory for Micro Samples

Micro Sample Holder (supplied standard)

*2 It is necessary to replace the standard light source mask with the supplied ø4 mm light source mask.

◆Sample size : Large

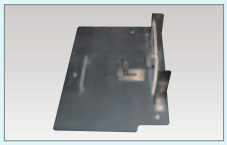
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No

### Transmittance Holder for Large Sample (P/N 1J0-0214)

A transmittance holder for samples of large size of 300 × 300 mm

Specifications

| Sample thickness | 25 mm or less |
|---|---|
| Sample size | 50 × 50 - 300 × 300 mm |



Transmittance Holder for Large Sample

◆Accessories for specific types of samples

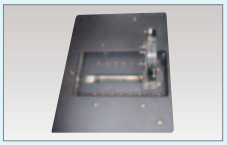
Lens

Sample size : Small → A transmittance measurement accessory for small lens is available as special order.

Sample size : Standard → Lens Transmittance Measurement Accessory (P/N 134-0201)

Specifications

| Incident angle | | 0° |
|---|---|---|
| Measurement method | | Transmittance measurement |
| Sample size | Lens holder (25 - 80) | ø25 - ø80 mm (peripheral thickness of 6 mm or less) |
| | Lens holder (40 - 110) | ø40 - ø110 mm (peripheral thickness of 6 mm or less) |

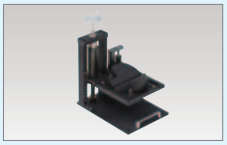


Lens Transmittance Measurement Accessory

Sample size : Large → Large Lens Measurement Accessory (P/N 134-0203)

Specifications

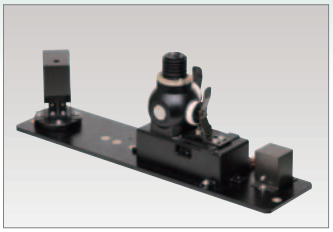
| Incident angle | 0° |
|---|---|
| Measurement method | Transmittance measurement |
| Sample size | ø50 - ø200 mm, length of 300 mm or less |



Large lens Measurement Accessory

# 60 mm Standard Full Integrating Sphere

## UH4150 : P/N 1J1-0122, U-4100 : P/N 134-0205



60 mm Standard Full Integrating Sphere

## Accessories for Reflectance Measurements

◆Sample size : Standard

Samples of glass, film, thin film, powder, resin plate, etc.

Total reflectance and Diffuse reflectance → Use the 60 mm Standard Integrating Sphere instead of the 60 mm Full Integrating Sphere, which is not appropriate for these measurements.

Samples of glass, film, thin film, etc.

Specular reflectance (absolute)

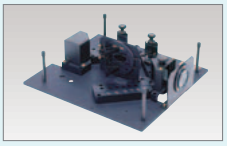
Incident angle : Variable (in increments of 10°)

- Variable Angle Absolute Reflectance Accessory (10° - 60°) (P/N 134-0116)
- Variable Angle Absolute Reflectance Accessory (15° - 65°) (P/N 134-0117)

Absolute reflectance of a sample is measured by the V-N method with the mirror relocated to the specified position. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Common specifications

| | |
|---|---|
| Sample thickness | P/N 134-0116 : 10° - 60° (in increments of 10°)<br>P/N 134-0117 : 15° - 65° (in increments of 10°) |
| Sample size | 8 × 8 - 90 × 100 mm |
| Wavelength range | 240 - 2,600 nm |



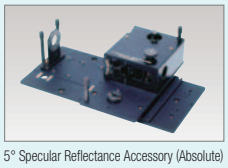
Variable Angle Absolute Reflectance Accessory

Incident angle : Continuously variable

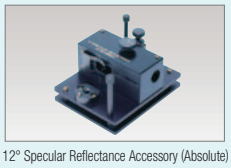
→ Use the Continuously Variable Angle Absolute Reflectance Accessory. Please see page 23 for details.

Incident angle : Fixed

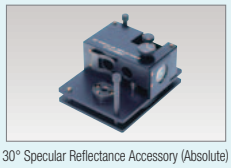
- 5° Specular Reflectance Accessory (Absolute) (P/N 134-0102)
- 12° Specular Reflectance Accessory (Absolute) (P/N 134-0104)
- 30° Specular Reflectance Accessory (Absolute) (P/N 134-0105)
  Polarizer Holder*1 (P/N 132-0325)
- 45° Specular Reflectance Accessory (Absolute) (P/N 134-0106)
  Polarizer Holder*1 (P/N 132-0325)



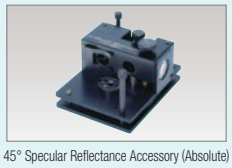
5° Specular Reflectance Accessory (Absolute)



12° Specular Reflectance Accessory (Absolute)



30° Specular Reflectance Accessory (Absolute)



45° Specular Reflectance Accessory (Absolute)

Used for measurement of reflective characteristics of metal films or glass surfaces depending on incident angle by measuring absolute reflectance using the V-N method. Transmittance measurement under the conditions of the same point and the same incident angle is also possible. In the case of the 30° and 45° Specular Reflectance Accessory, using a polarizer is required. (Some samples may require a polarizer even for 5° and 12° accessories.) Please see Reflectance Measurement Guide on page 4 for details. Samples are placed on the side of the accessory.

Common specifications

| | |
|---|---|
| Sample size | Absolute reflectance measurement;<br>25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |

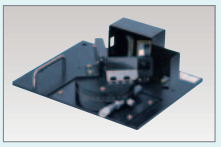
*1 A Glan-Taylor polarizer is required.

Samples of glass, film, thin film, etc.

Specular reflectance (relative reflectance) → Incident angle : Variable → **Variable Angle Reflectance Accessory (Relative) (P/N 134-0118)**

Specifications

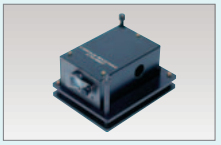
| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 25 × 25 - 50 × 100 mm |
| Wavelength range | 240 - 2,600 nm |


Variable Angle Reflectance Accessory (Relative)

Incident angle : Fixed → **5° Specular Reflectance Accessory (Relative) (P/N 134-0100)**

Specifications

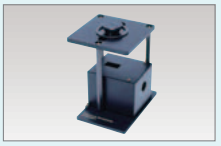
| | |
|---|---|
| Sample size | Relative reflectance measurement: 25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |


5° Specular Reflectance Accessory (Relative)

**Vertical 5° Specular Reflectance Accessory (Relative) (P/N 134-0101)**

Specifications

| | |
|---|---|
| Sample size | ø25 - ø100 mm |
| Wavelength range | 240 - 2,600 nm |

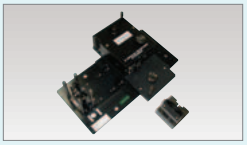

Vertical 5° Specular Reflectance Accessory (Relative)

The specular reflection of a reference sample is used to measure the sample reflectance relative to the reference.

◆Sample size : Small

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance → **Specially supplied to order**

Samples of glass, film, thin film, etc. → Specular reflectance (absolute) → Incident angle : Fixed → **Small 5° Specular Reflectance Accessory (Absolute) (P/N 134-0103)**


Small 5° Specular Reflectance Accessory (Absolute)

Specifications

| | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Incident angle | 5° ± 1° |
| Measurement method | Absolute reflectance and Relative reflectance |
| Light beam size | About 2.2 (W) × 2.2 (H) mm |
| Sample mounting unit | ø20 mm |
| Sample size | See the table to the right |

| Applicable sample size | |
|---|---|
| Standard measurement | ø25 - ø50 mm, 25 - 150 (W) × 25 - 100 (H) mm |
| Use of Micro Sample Holder (Supplied standard) | ø7 - ø17 mm, 5 × 5 - 12 × 12 mm |

The following accessory holders are separately supplied for much smaller samples.

Specifications

| | |
|---|---|
| Micro Sample Holder 2 (P/N 132-7401) | Measurement area : ø2 mm<br>Sample size : ø3 - ø18 mm<br>12 mm square or less |
| Micro Sample Holder 4 (P/N 132-7403) | Measurement area : ø4 mm<br>Sample size : ø5 - ø18 mm<br>12 mm square or less |

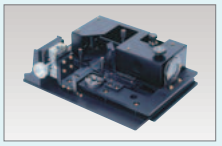

Micro Sample Holder (supplied standard)

◆Accessories for specific types of samples

Prism → Specular reflectance and transmittance (incident angle of 45°) → Sample size : Standard → **Prism Measurement Unit (P/N 134-0110)**

Specifications

| | |
|---|---|
| Incident angle | 45° |
| Sample size | 16 - 60 mm cube |
| Measuring point | Center |
| Wavelength range | 240 - 2,600 nm |

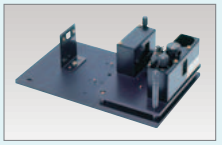

Prism Measurement Unit

Specular reflectance and transmittance (incident angle of 45°) → Sample size : Small → **Small Prism Measurement Unit (P/N 134-0111)**

Used for the measurement of transmittance and reflectance of various prisms at the incident angle of 45°. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Specifications

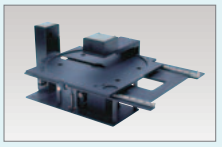
| | |
|---|---|
| Incident angle | 45° |
| Sample size | 5 - 6 mm square-cube<br>7 - 20 mm square-cube |
| Wavelength range | 240 - 2,600 nm |


Small Prism Measurement Unit

*1 A Glan-Taylor polarizer is required.

Wafer → Specular reflectance and transmittance (incident angle of 5°, relative reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0107)**

Specular reflectance and transmittance (incident angle of 12°, absolute reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0108)**


Top-mount Transmittance and Reflectance Measurement Unit

Common Specifications

| | |
|---|---|
| Incident angle | P/N 134-0107 : Transmittance; 0°, Reflectance; 5° (relative)<br>P/N 134-0108 : Transmittance; 0°, Reflectance; 12° (absolute) |
| Sample size | 50 × 50 - 230 × 230 mm, ø6 inch, ø8 inch |
| Wavelength range | 240 - 2,600 nm |

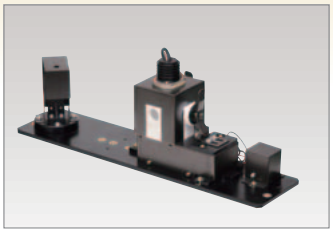
Measurement of transmittance and reflectance of large-size samples is possible by switching the light beam path.

Other sample holders for photomask, etc. are also available.

# 60 mm High-sensitivity Integrating Sphere for Reflectance Measurement

## UH4150 : P/N 1J1-0123, U-4100 : P/N 1J0-0210

This integrating sphere uses Spectralon®, which has the highest diffuse reflectance, for the inner surface material of the integrating sphere. It allows low-noise measurements compared to the standard integrating sphere, and is especially useful for measurement in the UV region of the spectrum. The rear port inclination angles are 8˚ for sample side and 0˚ for reference side, and both total and diffuse reflectance measurement are possible. With the 60 mm High-sensitivity Integrating Sphere for Reflectance Measurement, the following accessories are available for the respective measurement applications.



60 mm High-sensitivity Integrating Sphere for Reflectance Measurement

## Accessories for Transmittance and Absorbance Measurement

◆ Sample size : Standard

Samples of glass, film, thin film, etc.

Incident angle : 0˚

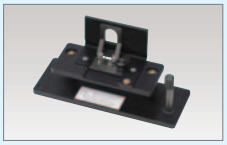
Diffusivity : No

### Glass Filter Holder for High-sensitivity Integrating sphere (P/N 134-0210)

Used for transmittance and absorbance measurement of plate solid samples, such as glass filter

Specifications

| | |
|---|---|
| Sample thickness | 0.5 - 5 mm |
| Sample size | 12 × 12 - 55 × 100 mm |



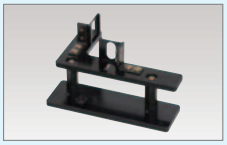
Glass Filter Holder for High-sensitivity Integrating sphere

### Film Holder for High-sensitivity Integrating sphere (P/N 134-0211)

Used for transmittance and absorbance measurement of thin film samples

Specifications

| | |
|---|---|
| Film frame | 25 mm wide, 30 - 55 mm high |
| Light beam opening | 10 mm wide, 20 mm high |



Film Holder for High-Sensitivity Integrating sphere

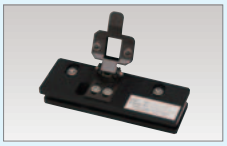
Diffusivity : Yes

### Transmittance Holder (close contact) (P/N 1J0-0202)

Used for transmittance and absorbance measurement of diffusive solid samples

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Transmittance Holder (close contact)

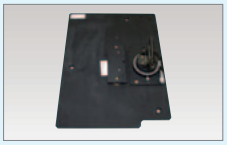
Incident angle : 0°- 60°

### Variable Angle Transmittance Accessory (P/N 134-0200) Polarizer Holder (P/N 132-0325) *1

A rotation stage is used for transmittance measurement under a desired incident angle from 0˚ to 60°. A polarizer and a polarizer holder are also used to remove the effect of polarization characteristics.

Specifications

| | |
|---|---|
| Incident angle | 0 - 60˚ |
| Light beam size | About 12.3 (H) × 8.5 (W) mm |
| Wavelength range | 240 - 2,600 nm |
| Sample size | 40 × 40 - 140 × 140 mm, thickness of 3 mm or less |



Variable Angle Transmittance Accessory

### (Option) Sample holder for P/N 134-0200 (P/N 134-6000)

Specifications

| | |
|---|---|
| Sample size | 25 × 25 - 50 × 50 mm, thickness of 3 mm or less |

*1 A Glan-Taylor polarizer is required.

Polarizing plate, etc.

Incident angle : 0°

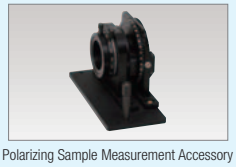
Diffusivity : No

### Polarizing plate Measurement Accessory (P/N 1J0-0208)

Used for the measurement of polarization characteristics by rotating two polarizing plates in the cross arrangement and the parallel arrangement. A polarizer and a polarizer holder (P/N 132-0325), or a depolarizer (P/N 134-6156) is needed separately.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Polarizing Sample Measurement Accessory

## Accessories for Transmittance and Absorbance Measurements

Liquid samples → Incident angle : 0° →

### 10 mm Rectangular Cell Holder for High-sensitivity Integrating sphere (P/N 134-0212)

10 mm Rectangular Cell Holder is used for measuring transmittance and absorbance of liquid samples. This holder is also required when using a filter calibration standard.

10 mm Rectangular Cell Holder for High-sensitivity Integrating sphere

◆Sample size : Small

Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No →

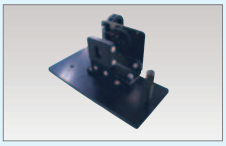
### Transmittance Measurement Accessory for Micro Samples (P/N 1J0-0204)

Used for measurement of micro samples of ø20 mm or less.
It includes a mask*2 that narrows down the light beam and a holder for the Micro sample.

Specifications

| Mask Type | Applicable Sample Size |
|---|---|
| ø3 mm Mask (supplied standard) | ø5 - ø20 mm, thickness 3 mm or less |
| ø1 mm Mask (supplied separately) | ø3 - ø20 mm, thickness 3 mm or less |

*2 It is necessary to replace the standard light source mask with the supplied ø4 mm light source mask.



Transmittance Measurement accessory for Micro Samples

Micro Sample Holder (supplied standard)

◆Sample size : Large

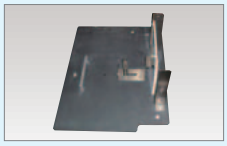
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No →

### Transmittance Holder for Large Sample (P/N 1J0-0214)

A transmittance holder for samples of large size of 300 × 300 mm

Specifications

| Sample thickness | 25 mm or less |
|---|---|
| Sample size | 50 × 50 - 300 × 300 mm |



Transmittance Holder for Large Sample

◆Accessories for specific types of samples

Lens

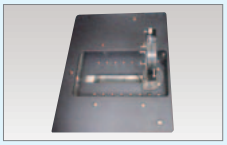
Sample size : Small → A transmittance measurement accessory for small lens is available as special order.

Sample size : Standard →

### Lens Transmittance Measurement Accessory (P/N 134-0201)

Specifications

| Incident angle | | 0° |
|---|---|---|
| Measurement method | | Transmittance measurement |
| Sample size | Lens holder (25 - 80) | ø25 - ø80 mm (peripheral thickness of 6 mm or less) |
| | Lens holder (40 - 110) | ø40 - ø110 mm (peripheral thickness of 6 mm or less) |



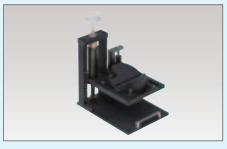
Lens Transmittance Measurement Accessory

Sample size : Large →

### Large Lens Measurement Accessory (P/N 134-0203)

Specifications

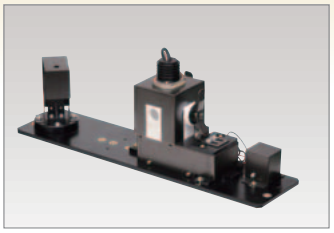
| Incident angle | 0° |
|---|---|
| Measurement method | Transmittance measurement |
| Sample size | ø50 - ø200 mm, length of 300 mm or less |



Large lens Measurement Accessory

# 60 mm High-sensitivity Integrating Sphere for Reflectance Measurement

## UH4150 : P/N 1J1-0123, U-4100 : P/N 1J0-0210



Appearance of 60 mm High-sensitivity Integrating Sphere for Reflectance Measurement

## Accessories for Reflectance Measurements

◆Sample size : Standard

Samples of glass, film, thin film, powder, resin plate, etc.

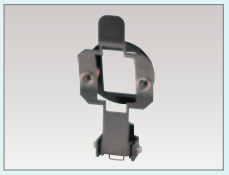
Total reflectance, diffuse reflectance

- Opaque → Possible to measure without any accessory
- Transparent → White Plate Holder with Transmission Hole (P/N 130-2179)

Used for total reflectance measurement of transparent samples (glasses etc.). It is constructed to prevent transmitted light from entering into the integrating sphere.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 50 × 50 - 300 × 300 mm |



White Plate Holder with Transmission Hole

Samples of glass, film, thin film, etc.

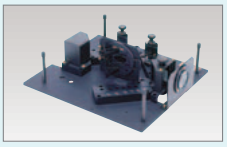
Specular reflectance (absolute)

- Incident angle : Variable (in increments of 10°)
  - → Variable Angle Absolute Reflectance Accessory (10° - 60°) (P/N 134-0116)
  - → Variable Angle Absolute Reflectance Accessory (15° - 65°) (P/N 134-0117)

Absolute reflectance of a sample is measured by the V-N method with the mirror relocated to the specified position. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

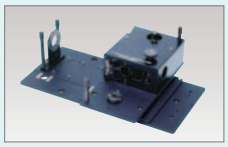
Common specifications

| | |
|---|---|
| Sample thickness | P/N 134-0116 : 10° - 60° (in increments of 10°)<br>P/N 134-0117 : 15° - 65° (in increments of 10°) |
| Sample size | 8 × 8 - 90 × 100 mm |
| Wavelength range | 240 - 2,600 nm |

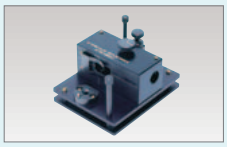


Variable Angle Absolute Reflectance Accessory

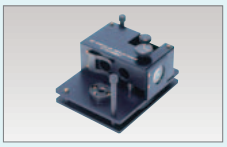
- Incident angle : Continuously variable → Use the Continuously Variable Angle Absolute Reflectance Accessory. Please see page 23 for details.
- Incident angle : Fixed
  - → 5° Specular Reflectance Accessory (Absolute) (P/N 134-0102)
  - → 12° Specular Reflectance Accessory (Absolute) (P/N 134-0104)
  - → 30° Specular Reflectance Accessory (Absolute) (P/N 134-0105)
    Polarizer Holder*1 (P/N 132-0325)
  - → 45° Specular Reflectance Accessory (Absolute) (P/N 134-0106)
    Polarizer Holder*1 (P/N 132-0325)



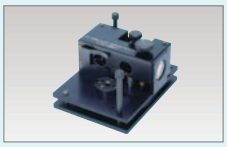
5° Specular Reflectance Accessory (Absolute)



12° Specular Reflectance Accessory (Absolute)



30° Specular Reflectance Accessory (Absolute)



45° Specular Reflectance Accessory (Absolute)

Used for measurement of reflective characteristics of metal films or glass surfaces depending on incident angle by measuring absolute reflectance using the V-N method. Transmittance measurement under the conditions of the same point and the same incident angle is also possible. In the case of the 30° and 45° Specular Reflectance Accessory, using a polarizer is required. (Some samples may require a polarizer even for 5° and 12° accessories.) Please see Reflectance Measurement Guide on page 4 for details. Samples are placed on the side of the accessory.

Common specifications

| | |
|---|---|
| Sample size | Absolute reflectance measurement;<br>25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |

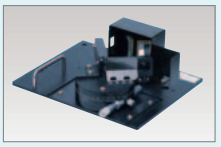
*1 A Glan-Taylor polarizer is required.

Samples of glass, film, thin film, etc.

Specular reflectance (relative reflectance) → Incident angle : Variable → **Variable Angle Reflectance Accessory (Relative) (P/N 134-0118)**

Specifications

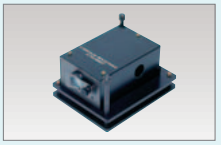
| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 25 × 25 - 50 × 100 mm |
| Wavelength range | 240 - 2,600 nm |


Variable Angle Reflectance Accessory (Relative)

Specular reflectance (relative reflectance) → Incident angle : Fixed → **5° Specular Reflectance Accessory (Relative) (P/N 134-0100)**

Specifications

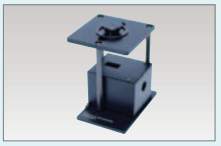
| | |
|---|---|
| Sample size | Relative reflectance measurement: 25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |


5° Specular Reflectance Accessory (Relative)

Incident angle : Fixed → **Vertical 5° Specular Reflectance Accessory (Relative) (P/N 134-0101)**

Specifications

| | |
|---|---|
| Sample size | ø25 - ø100 mm |
| Wavelength range | 240 - 2,600 nm |

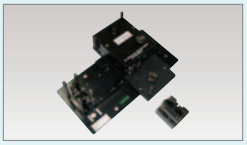

Vertical 5° Specular Reflectance Accessory (Relative)

The specular reflection of a reference sample is used to measure the sample reflectance relative to the reference.

◆Sample size : Small

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance → **Specially supplied to order**

Samples of glass, film, thin film, etc. → Specular reflectance (absolute) → Incident angle : Fixed → **Small 5° Specular Reflectance Accessory (Absolute) (P/N 134-0103)**


Small 5° Specular Reflectance Accessory (Absolute)

Specifications

| | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Incident angle | 5° ± 1° |
| Measurement method | Absolute reflectance and Relative reflectance |
| Light beam size | About 2.2 (W) × 2.2 (H) mm |
| Sample mounting unit | ø20 mm |
| Sample size | See the table to the right |

| Applicable sample size | |
|---|---|
| Standard measurement | ø25 - ø50 mm, 25 - 150 (W) × 25 - 100 (H) mm |
| Use of Micro Sample Holder (Supplied standard) | ø7 - ø17 mm, 5 × 5 - 12 × 12 mm |

The following accessory holders are separately supplied for much smaller samples.

Specifications

| | |
|---|---|
| Micro Sample Holder 2 (P/N 132-7401) | Measurement area : ø2 mm<br>Sample size : ø3 - ø18 mm<br>12 mm square or less |
| Micro Sample Holder 4 (P/N 132-7403) | Measurement area : ø4 mm<br>Sample size : ø5 - ø18 mm<br>12 mm square or less |

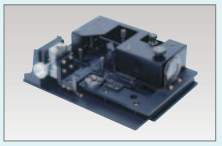

Micro Sample Holder (supplied standard)

◆Accessories for specific types of samples

Prism → Specular reflectance and transmittance (incident angle of 45°) → Sample size : Standard → **Prism Measurement Unit (P/N 134-0110)**

Specifications

| | |
|---|---|
| Incident angle | 45° |
| Sample size | 16 - 60 mm cube |
| Measuring point | Center |
| Wavelength range | 240 - 2,600 nm |

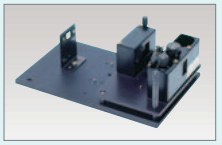

Prism Measurement Unit

Specular reflectance and transmittance (incident angle of 45°) → Sample size : Small → **Small Prism Measurement Unit (P/N 134-0111)**

Used for the measurement of transmittance and reflectance of various prisms at the incident angle of 45°. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Specifications

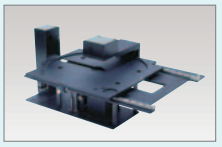
| | |
|---|---|
| Incident angle | 45° |
| Sample size | 5 - 6 mm square-cube<br>7 - 20 mm square-cube |
| Wavelength range | 240 - 2,600 nm |


Small Prism Measurement Unit

*1 A Glan-Taylor polarizer is required.

Wafer → Specular reflectance and transmittance (incident angle of 5°, relative reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0107)**

Specular reflectance and transmittance (incident angle of 12°, absolute reflectance) → **Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0108)**


Top-mount Transmittance and Reflectance Measurement Unit

Common Specifications

| | |
|---|---|
| Incident angle | P/N 134-0107 : Transmittance; 0°, Reflectance; 5° (relative)<br>P/N 134-0108 : Transmittance; 0°, Reflectance; 12° (absolute) |
| Sample size | 50 × 50 - 230 × 230 mm, ø6 inch, ø8 inch |
| Wavelength range | 240 - 2,600 nm |

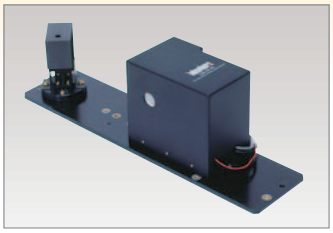
Measurement of transmittance and reflectance of large-size samples is possible by switching the light beam path.

Other sample holders for photomask, etc. are also available.

# 60 mm High-sensitivity Full Integrating Sphere

## UH4150 : P/N 1J1-0124, U-4100 : P/N 134-0206

This integrating sphere uses Spectralon®, which has the highest diffuse reflectance, for the inner surface material of integrating sphere. It allows lower-noise measurements compared to the standard integrating sphere, and is especially useful for measurement in the UV region of spectrum. This type of integrating sphere has no rear-side ports, and is suitable for measurement of lenses and other samples, of which transmitted light beam changes in shape. However, total reflectance and diffuse reflectance measurement are not available. With the 60 mm High-sensitivity Full Integrating Sphere, the following accessories are available for the respective measurement applications.



60 mm High-sensitivity Full Integrating Sphere

## Accessories for Transmittance and Absorbance Measurement

◆Sample size : Standard

Samples of glass, film, thin film, etc.

Incident angle : 0°

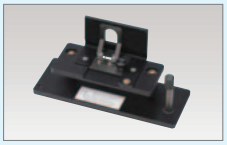
Diffusivity : No

### Glass Filter Holder for High-sensitivity Integrating sphere (P/N 134-0210)

Used for transmittance and absorbance measurement of plate solid samples, such as glass filter

Specifications

| | |
|---|---|
| Sample thickness | 0.5 - 5 mm |
| Sample size | 12 × 12 - 55 × 100 mm |



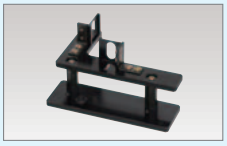
Glass Filter Holder for High-sensitivity Integrating sphere

### Film Holder for High-sensitivity Integrating sphere (P/N 134-0211)

Used for transmittance and absorbance measurement of thin film samples

Specifications

| | |
|---|---|
| Film frame | 25 mm wide, 30 - 55 mm high |
| Light beam opening | 10 mm wide, 20 mm high |



Film Holder for High-Sensitivity Integrating sphere

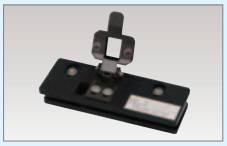
Diffusivity : Yes

### Transmittance Holder (close contact) (P/N 1J0-0202)

Used for transmittance and absorbance measurement of diffusive solid samples

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Transmittance Holder (close contact)

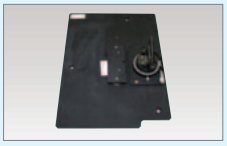
Incident angle : 0°- 60°

### Variable Angle Transmittance Accessory (P/N 134-0200)
### Polarizer Holder (P/N 132-0325) *1

A rotation stage is used for transmittance measurement under a desired incident angle from 0° to 60°. A polarizer and a polarizer holder are also used to remove the effect of polarization characteristics.

Specifications

| | |
|---|---|
| Incident angle | 0 - 60° |
| Light beam size | About 12.3 (H) × 8.5 (W) mm |
| Wavelength range | 240 - 2,600 nm |
| Sample size | 40 × 40 - 140 × 140 mm, thickness of 3 mm or less |



Variable Angle Transmittance Accessory

### (Option) Sample holder for P/N 134-0200 (P/N 134-6000)

Specifications

| | |
|---|---|
| Sample size | 25 × 25 - 50 × 50 mm, thickness of 3 mm or less |

*1 A Glan-Taylor polarizer is required.

Polarizing plate, etc.

Incident angle : 0°

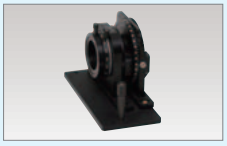
Diffusivity : No

### Polarizing plate Measurement Accessory (P/N 1J0-0208)

Used for the measurement of polarization characteristics by rotating two polarizing plates in the cross arrangement and the parallel arrangement. A polarizer and a polarizer holder (P/N 132-0325), or a depolarizer (P/N 134-6156) is needed separately.

Specifications

| | |
|---|---|
| Sample thickness | 25 mm or less |
| Sample size | 30 × 30 - 100 × 100 mm |



Polarizing Sample Measurement Accessory

## Accessories for Transmittance and Absorbance Measurements

Liquid samples → Incident angle : 0° →

### 10 mm Rectangular Cell Holder for High-sensitivity Integrating sphere (P/N 134-0212)

10 mm Rectangular Cell Holder is used for measuring transmittance and absorbance of liquid samples. This holder is also required when using a filter calibration standard.

10 mm Rectangular Cell Holder for High-sensitivity Integrating sphere

◆Sample size : Small

Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No →

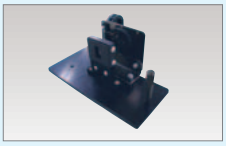
### Transmittance Measurement Accessory for Micro Samples (P/N 1J0-0204)

Used for measurement of micro samples of ø20 mm or less.
It includes a mask*2 that narrows down the light beam and a holder for the Micro sample.

Specifications

| Mask Type | Applicable Sample Size |
|---|---|
| ø3 mm Mask (supplied standard) | ø5 - ø20 mm, thickness 3 mm or less |
| ø1 mm Mask (supplied separately) | ø3 - ø20 mm, thickness 3 mm or less |

*2 It is necessary to replace the standard light source mask with the supplied ø4 mm light source mask.



Transmittance Measurement accessory for Micro Samples

Micro Sample Holder (supplied standard)

◆Sample size : Large

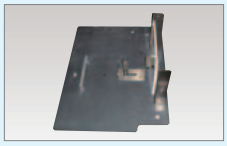
Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No →

### Transmittance Holder for Large Sample (P/N 1J0-0214)

A transmittance holder for samples of large size of 300 × 300 mm

Specifications

| Sample thickness | 25 mm or less |
|---|---|
| Sample size | 50 × 50 - 300 × 300 mm |



Transmittance Holder for Large Sample

◆Accessories for specific types of samples

Lens*4 →

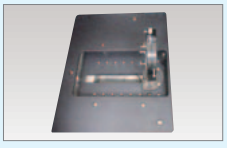
Sample size : Small → A transmittance measurement accessory for small lens is available as special order.

Sample size : Standard →

### Lens Transmittance Measurement Accessory (P/N 134-0201)

Specifications

| Incident angle | | 0° |
|---|---|---|
| Measurement method | | Transmittance measurement |
| Sample size | Lens holder (25 - 80) | ø25 - ø80 mm (peripheral thickness of 6 mm or less) |
| | Lens holder (40 - 110) | ø40 - ø110 mm (peripheral thickness of 6 mm or less) |



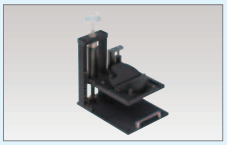
Lens Transmittance Measurement Accessory

Sample size : Large →

### Large Lens Measurement Accessory (P/N 134-0203)

Specifications

| Incident angle | 0° |
|---|---|
| Measurement method | Transmittance measurement |
| Sample size | ø50 - ø200 mm, length of 300 mm or less |

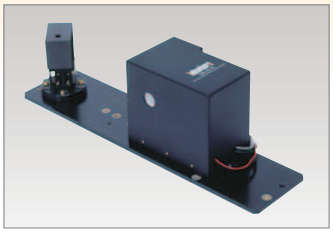


Large lens Measurement Accessory

*4 In case of very short focal length, a measurement error could occur. This is because the light may hit the detector directly due to the baffle structure of the 60 mm High Sensitivity Full Integrating Sphere. In this case, use the 60 mm High-sensitivity Integrating Sphere for reflectance measurement (UH4150 : P/N 1J1-0123, U-4100 : P/N 1J0-0210) .

# 60 mm High-sensitivity Full Integrating Sphere

## UH4150 : 1J1-0124, U-4100 : 134-0206



60 mm High-sensitivity Full Integrating Spher

## Accessories for Reflectance Measurements

◆Sample size : Standard

Samples of glass, film, thin film, powder, resin plate, etc.

Total reflectance, diffuse reflectance

→ Use the 60 mm High-sensitivity Integrating Sphere for Reflectance measurement instead of the 60 mm High-sensitivity Full Integrating Sphere, which is not capable of these measurements.

Samples of glass, film, thin film, etc.

Specular reflectance (absolute)

Incident angle : Variable (in increments of 10°)

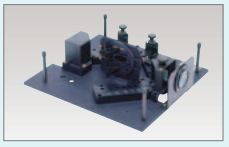
→ Variable Angle Absolute Reflectance Accessory (10° - 60°) (P/N 134-0116)

→ Variable Angle Absolute Reflectance Accessory (15° - 65°) (P/N 134-0117)

Absolute reflectance of a sample is measured by the V-N method with the mirror relocated to the specified position. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Common specifications

| | |
|---|---|
| Sample thickness | P/N 134-0116 : 10° - 60° (in increments of 10°)<br>P/N 134-0117 : 15° - 65° (in increments of 10°) |
| Sample size | 8 × 8 - 90 × 100 mm |
| Wavelength range | 240 - 2,600 nm |



Variable Angle Absolute Reflectance Accessory

Incident angle : Continuously variable

→ Use the Continuously Variable Angle Absolute Reflectance Accessory. Please see page 23 for details.

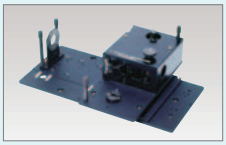
Incident angle : Fixed

→ 5° Specular Reflectance Accessory (Absolute) (P/N 134-0102)

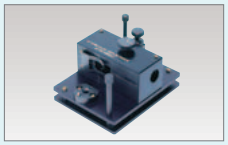
→ 12° Specular Reflectance Accessory (Absolute) (P/N 134-0104)

→ 30° Specular Reflectance Accessory (Absolute) (P/N 134-0105)
Polarizer Holder*1 (P/N 132-0325)

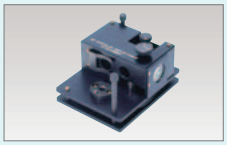
→ 45° Specular Reflectance Accessory (Absolute) (P/N 134-0106)
Polarizer Holder*1 (P/N 132-0325)



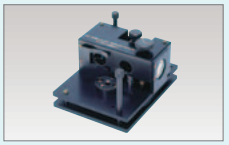
5° Specular Reflectance Accessory (Absolute)



12° Specular Reflectance Accessory (Absolute)



30° Specular Reflectance Accessory (Absolute)



45° Specular Reflectance Accessory (Absolute)

Used for measurement of reflective characteristics of metal films or glass surfaces depending on incident angle by measuring absolute reflectance using the V-N method. Transmittance measurement under the conditions of the same point and the same incident angle is also possible. In the case of the 30° and 45° Specular Reflectance Accessory, using a polarizer is required. (Some samples may require a polarizer even for 5° and 12° accessories.) Please see Reflectance Measurement Guide on page 4 for details. Samples are placed on the side of the accessory.

Common specifications

| | |
|---|---|
| Sample size | Absolute reflectance measurement;<br>25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |

*1 A Glan-Taylor polarizer is required.

Samples of glass, film, thin film, etc.

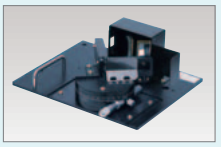
Specular reflectance (relative reflectance) → Incident angle : Variable

### Variable Angle Reflectance Accessory (Relative) (P/N 134-0118)

The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Specifications

| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 25 × 25 - 50 × 100 mm |
| Wavelength range | 240 - 2,600 nm |



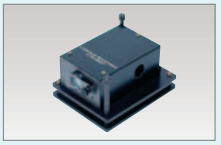
Variable Angle Reflectance Accessory (Relative)

Specular reflectance (relative reflectance) → Incident angle : Fixed

### 5° Specular Reflectance Accessory (Relative) (P/N 134-0100)

Specifications

| | |
|---|---|
| Sample size | Relative reflectance measurement: 25 × 25 - 100 × 150 mm |
| Wavelength range | 240 - 2,600 nm |

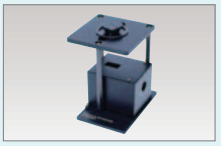


5° Specular Reflectance Accessory (Relative)

### Vertical 5° Specular Reflectance Accessory (Relative) (P/N 134-0101)

Specifications

| | |
|---|---|
| Sample size | ø25 - ø100 mm |
| Wavelength range | 240 - 2,600 nm |



Vertical 5° Specular Reflectance Accessory (Relative)

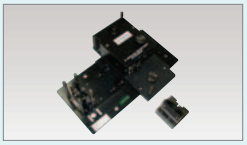
The specular reflection of a reference sample is used to measure the sample reflectance relative to the reference.

◆Sample size : Small

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance → Specially supplied to order

Samples of glass, film, thin film, etc. → Specular reflectance (absolute) → Incident angle : Fixed

### Small 5° Specular Reflectance Accessory (Absolute) (P/N 134-0103)



Small 5° Specular Reflectance Accessory (Absolute)

Specifications

| | |
|---|---|
| Wavelength range | 240 - 2,600 nm |
| Incident angle | 5° ± 1° |
| Measurement method | Absolute reflectance and Relative reflectance |
| Light beam size | About 2.2 (W) × 2.2 (H) mm |
| Sample mounting unit | ø20 mm |
| Sample size | See the table to the right |

| Applicable sample size | |
|---|---|
| Standard measurement | ø25 - ø50 mm, 25 - 150 (W) × 25 - 100 (H) mm |
| Use of Micro Sample Holder (Supplied standard) | ø7 - ø17 mm, 5 × 5 - 12 × 12 mm |

The following accessory holders are separately supplied for much smaller samples.

Specifications

| | |
|---|---|
| Micro Sample Holder 2 (P/N 132-7401) | Measurement area : ø2 mm<br>Sample size : ø3 - ø18 mm<br>12 mm square or less |
| Micro Sample Holder 4 (P/N 132-7403) | Measurement area : ø4 mm<br>Sample size : ø5 - ø18 mm<br>12 mm square or less |

Micro Sample Holder (supplied standard)

◆Accessories for specific types of samples

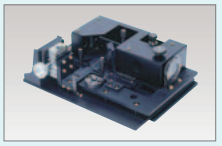
Prism → Specular reflectance and transmittance (incident angle of 45°)

Specular reflectance and transmittance (incident angle of 45°) → Sample size : Standard

### Prism Measurement Unit (P/N 134-0110)

Specifications

| | |
|---|---|
| Incident angle | 45° |
| Sample size | 16 - 60 mm cube |
| Measuring point | Center |
| Wavelength range | 240 - 2,600 nm |



Prism Measurement Unit

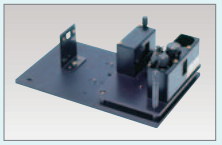
Specular reflectance and transmittance (incident angle of 45°) → Sample size : Small

### Small Prism Measurement Unit (P/N 134-0111)

Used for the measurement of transmittance and reflectance of various prisms at the incident angle of 45°. The Polarizer Holder*1 (P/N 132-0325) is supplied standard.

Specifications

| | |
|---|---|
| Incident angle | 45° |
| Sample size | 5 - 6 mm square-cube<br>7 - 20 mm square-cube |
| Wavelength range | 240 - 2,600 nm |



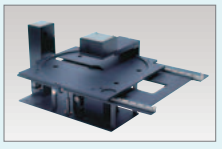
Small Prism Measurement Unit

*1 A Glan-Taylor polarizer is required.

Wafer

Specular reflectance and transmittance (incident angle of 5°, relative reflectance) → Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0107)

Specular reflectance and transmittance (incident angle of 12°, absolute reflectance) → Top-mount Transmittance and Reflectance Measurement Unit (P/N 134-0108)



Top-mount Transmittance and Reflectance Measurement Unit

Common Specifications

| | |
|---|---|
| Incident angle | P/N 134-0107 : Transmittance; 0°, Reflectance; 5° (relative)<br>P/N 134-0108 : Transmittance; 0°, Reflectance; 12° (absolute) |
| Sample size | 50 × 50 - 230 × 230 mm, ø6 inch, ø8 inch |
| Wavelength range | 240 - 2,600 nm |

Measurement of transmittance and reflectance of large-size samples is possible by switching the light beam path.

Other sample holders for photomask, etc. are also available.

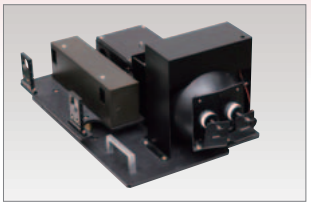
# 150 mm Standard Integrating Sphere with Optical Trap

## UH4150, U-4100 : P/N 1J0-0212

This integrating sphere*5 is a large-size integrating sphere of ø150 mm, which uses $BaSO_4$ for the inner surface material. Since its opening ratio is smaller than the 60 mm integrating sphere, it is useful for diffuse reflectance and total reflectance measurement or color analysis of samples with high diffusivity. With the 150 mm Standard Integrating Sphere, the following accessories are available for respective measurement applications.

Specifications

| | |
|---|---|
| Wavelength range | 350 - 750 nm |
| Baseline flatness | 100 ± 0.5%T or less |



150 mm Standard Integrating Sphere with Optical Trap

### Transmittance and Absorbance Measurement

◆ Sample size : Standard

Liquid samples → Incident angle : 0° → This accessory allows the measurements of liquid samples.

Solid sample holder is specially supplied to order.

Specifications

| | |
|---|---|
| Light beam path length | 10, 20, 30, 40, and 50 mm; rectangular cell |

### Reflectance Measurement

◆ Sample size : Standard

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance and diffuse reflectance → Opaque → This accessory allows the measurements of the samples.

Total reflectance and diffuse reflectance → Transparent → Specially supplied to order

Specifications

| | |
|---|---|
| Sample thickness | 15 mm or less |
| Sample size | ø25 - 60 × 60 mm |

For diffuse reflectance measurement, an optical trap is used to remove specular light.

# 150 mm High-sensitivity Integrating Sphere with Optical Trap

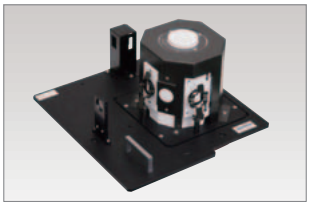
## UH4150 : P/N 1J1-0126*, U-4100 : 1J0-0376*

* Produced on order item.

This integrating sphere*5 is a large-size integrating sphere of ø150 mm, which uses Spectralon® for the inner surface material. Since its opening ratio is smaller than the 60 mm integrating sphere, it is useful for diffuse and total reflectance measurements or color analysis of samples having high diffusivity. With the 150 mm High-sensitivity Integrating Sphere, the following accessories are available for the respective measurement applications.

Specifications

| | |
|---|---|
| Wavelength range | 240 - 2,500 nm |
| Baseline flatness | ±0.002 Abs or less (240 - 2,000 nm)<br>±0.004 Abs or less (2,000 - 2,500 nm) |



150 mm High-sensitivity Integrating Sphere with Optical Trap

### Transmittance and Absorbance Measurement

Samples of glass, film, thin film, etc. → Incident angle : 0° → This accessory allows the measurements of the samples.

Diffusivity : Yes/No

Specifications

| | |
|---|---|
| Sample thickness | 10 mm or less |
| Sample size | ø25 - ø100 mm |

### Reflectance Measurement

Samples of glass, film, thin film, powder, resin plate, etc. → Total reflectance and diffuse reflectance → Opaque/Transparent → This accessory allows the measurements of the samples.

For diffuse reflectance measurement, an optical trap is used to remove specular light.

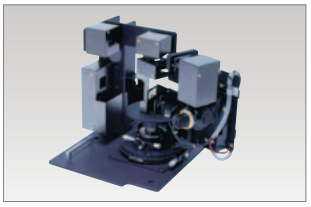
Specifications

| | |
|---|---|
| Sample thickness | 10 mm or less |
| Sample size | ø30 - ø50 mm |

# Continuously Variable Angle Absolute Reflectance Accessory

## Standard-sample version (UH4150 : P/N 1J1-0131), Micro-sample version (P/N 1J1-0132)
## Standard-sample version (U-4100 : P/N 134-0115), Micro-sample version (P/N 1J0-0206)

This accessory*5 is used for the measurement of transmittance and absolute specular reflectance under a desired angle from 20° to 60°, or of distribution of diffuse light by independently rotating the sample stage and the detector (full integrating sphere). Using a polarizer is required. The Polarizer Holder is supplied standard. A Micro-sample version of this accessory is also available, which includes a light source mask, a condenser lens, and a micro sample holder.



Continuously Variable Angle Absolute Reflectance Accessory

### Transmittance and Absorbance Measurement

Samples of glass, film, thin film, etc. → Incident angle : Variable → This accessory allows the measurements of the samples.

Specifications (Standard-sample version)

| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | Flat substrate; 30 × 30 - 90 × 90 mm<br>Prism; cube of 85 mm or less |
| Wavelength range | 240 - 2,600 nm |

### Reflectance Measurement

Samples of glass, film, thin film, powder, resin plate, etc. → Specular reflectance → Incident angle : Variable (free) → This accessory allows the measurements of the samples.

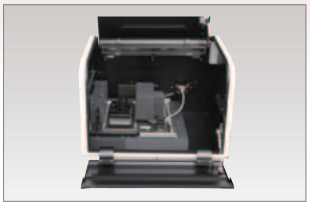
Specifications (Micro-sample version)

| | |
|---|---|
| Incident angle | 20° - 60° |
| Sample size | 3.5 × 3.5 - 90 × 90 mm |
| Sample thickness | Sample size : 3.5 - 26 mm · · · 3 mm or less<br>Sample size : 26 - 90 mm · · · 5 mm or less |
| Wavelength range | 340 - 2,000 nm |

*5 In order to carry out calibration and performance check of UH4150 Integrating sphere Detection System, the 60 mm integrating sphere is required.

# Accessories for UH4150 Direct Light Detection System
# Accessories for U-4100 with Detector Attachment
# Accessories for U-4100 Liquid Sample Measurement System

These systems are equipped with a direct light detector instead of an integrating sphere. These systems have a wide wavelength range* and allow absorbance and transmittance measurements of a variety of samples. A 10 mm Rectangular Cell Holder is included.



Sample compartment of Direct Light Detection System of Model UH4150

* 185 nm to 3,300 nm for UH4150, 190 nm to 3,300 nm for U-4100.

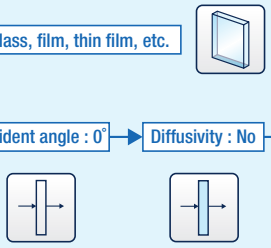
## Absorbance Measurement

Liquid samples → Various types of accessories are available to meet the needs of different cell shapes and sample volumes.

| P/N | Description | Explanation |
|---|---|---|
| 210-2107 | Rectangular long path cell holder | Accepts 10, 20, 30, 40, 50, or 100 mm cells |
| 210-2108 | Cylindrical long path cell holder | Accepts 10, 20, 50, or 100 mm cells, Outside diameter of cells : 30 mm |
| 124-0357 | 10 mm Micro quartz cell | A pair of two cells. Allows a sample volume of 340 µL to 600 µL. Requirements are single cell holder (3J1-0106) and mask for micro cell (200-1537 or 200-1538). |
| 200-1537 | Mask for micro cell (mask width of 1.5 mm) | Two masks are needed. Used combined with 10 mm micro quartz cell (124-0375) and single cell holder (3J1-0106) |
| 200-1538 | Mask for micro cell (mask width of 1.2 mm) | Two masks are needed. Used combined with 10 mm micro quartz cell (124-0375) and single cell holder (3J1-0106) |
| 200-0551 | Black 10 mm Micro quartz cell | A pair of two cells. Allows a sample volume of 340 µL to 600 µL. Mask for micro cell is not needed. |
| 3J1-0106 | Single cell holder | Used combined with 10 mm micro quartz cell (124-0357) and mask for micro cell (200-1537 or 200-1538) |
| 122-0060 | Micro cell holder | Cells are not included. Cells are supplied separately (see below). |
| 130-0621 | 5 µL Micro cell | Used combined with micro cell holder (122-0060) |
| 130-0623 | 25 µL Micro cell | Used combined with micro cell holder (122-0060) |
| 130-0622 | 50 µL Micro cell | Used combined with micro cell holder (122-0060) |

## Transmittance Measurement

Samples of glass, film, thin film, etc. → Incident angle : 0° → Diffusivity : No



### Glass Filter Holder for direct light detection (P/N 210-2109)

Used for transmittance and absorbance measurement of plate solid samples, such as glass filter

Specifications

| | |
|---|---|
| Sample thickness | 0.5 - 5 mm |
| Sample size | 12 × 25 - 55 × 100 mm |

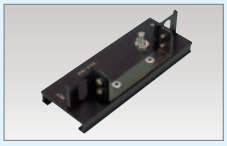
Glass Filter Holder

### Film Holder for direct light detection (P/N 210-2112)

Used for transmittance and absorbance measurement of film samples

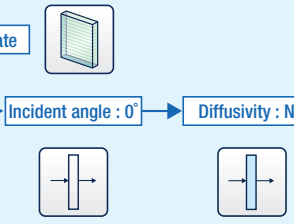
Specifications

| | |
|---|---|
| Film frame | 25 mm wide, 30 - 55 mm high |
| Light beam opening | 10 mm wide, 20 mm high |



Film Filter Holder

Polarizing plate → Incident angle : 0° → Diffusivity : No

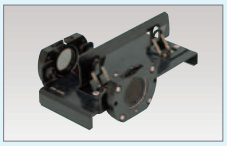


### Polarizer Holder for direct light detection (P/N 210-2130)

Used for the measurement of polarizer characteristics by rotating two polarizing plates in the cross arrangement and the parallel arrangement

Specifications

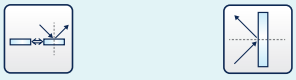
| | |
|---|---|
| Wavelength range | 400 - 750 nm |
| Sample surface area | 12 - 25 mm to 55 - 100 mm |
| Sample thickness | 0.5 - 5 mm |



Polarizer Holder

## Reflectance Measurement

Samples of glass, film, thin film, etc. → Specular reflectance (relative reflectance) → Incident angle : 5° → 5° Specular Reflectance Accessory (Relative) (P/N 134-0226)



Specifications

| | |
|---|---|
| Incident angle | 5° |
| Sample surface area | Diameter of 25 mm or more |

5° Specular Reflectance Accessory (Relative)

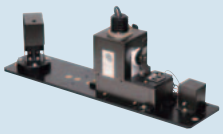
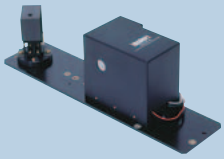
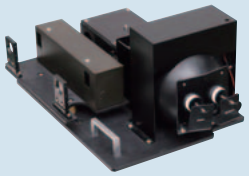
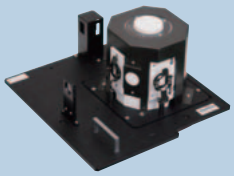
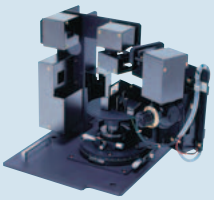
# Summary of Integrating Sphere Detectors

| | | | 60 mm Standard Integrating Sphere (for both total reflectance and diffuse reflectance) | 60 mm Standard Integrating Sphere (for total reflectance) | 60 mm Standard Full Integrating Sphere |
|---|---|---|---|---|---|
| Appearance | | |  |  |  |
| Compatible system | UH4150 | Integrating Sphere Light Receiving System *1 | ● | ● | ● |
| | | Direct Light Receiving System *2 | ● | ● | ● |
| | | Part number | 1J1-0120 | 1J1-0121 | 1J1-0122 |
| | U-4100 | Liquid sample measurement system | Not available | Not available | Not available |
| | | Solid sample measurement system | ● | ●*6 | ● |
| | | Large sample measurement System | ● | ●*6 | ● |
| | | UV Region measurement system | ● | ● | ● |
| | | Part number | 1J0-0216*7 | 134-0218 | 134-0205 |
| Wavelength | | Far UV | Not available | Not available | Not available |
| | | Near UV | ● | ● | ● |
| | | Visible | ● | ● | ● |
| | | Near infrared | ● | ● | ● |
| | | Wavelength range | 240 - 2,600 nm | 240 - 2,600 nm | 240 - 2,600 nm |
| Structure | | Inner material | $BaSO_4$ | $BaSO_4$ | $BaSO_4$ |
| | | Sub white plate material | $Al_2O_3$ | $Al_2O_3$ | Not used |
| | | Number of ports | 4 | 4 | 2 |
| | Port-inclination Angle | Sample side | 8° | 10° | No ports |
| | | Reference side | 0° | 10° | No ports |
| Measurement | | Transmittance | ● | ● | ● |
| | | Absorbance | ● | ● | ● |
| | | Scattered light | ● | ● | ● |
| | | Total reflectance | ● | ● | Not available |
| | | Diffuse reflectance | ● | Not available | Not available |
| | | Specular reflectance | ● | ● | ● |

*5 In order to carry out calibration and performance check of UH4150 Integrating sphere Detection System, the 60 mm integrating sphere is required.

*6 This Integrating sphere is supplied with main unit of U-4100 as standard.

*7 Produced on order item.

| 60 mm High-sensitivity Integrating Sphere (for Reflectance Measurement) | 60 mm High-sensitivity Full Integrating Sphere | 150 mm Standard Integrating Sphere*5 (with Optical Trap) | 150 mm High-sensitivity Integrating Sphere*5 (with Optical Trap) | Continuously Variable Angle Absolute Reflectance Accessory*5 |
|---|---|---|---|---|
|  |  |  |  |  |
| ● | ● | ● | ● | ● |
| ● | ● | ● | ● | ● |
| 1J1-0123 | 1J1-0124 | 1J0-0212 | 1J1-0126*7 | (Standard-sample version) 1J1-0131 (Micro-sample version) 1J1-0132 |
| Not available | Not available | Not available | Not available | Not available |
| ● | ● | ● | ● | Not available |
| ● | ● | ● | ● | ● |
| ● | ●*6 | ● | ● | Not available |
| 1J0-0210 | 134-0206 | 1J0-0212 | 1J0-0376*7 | (Standard-sample version) 134-0115 (Micro-sample version) 1J0-0206 |
| Not available | Not available | Not available | Not available | Not available |
| ● | ● | ● | ● | ● |
| ● | ● | Not available | ● | ● |
| ● | ● | Not available | ● | ● |
| 190 - 2,600 nm | 190 - 2,600 nm | 350 - 750 nm | 240 - 2,500 nm | (Standard-sample version) 240 - 2,600 nm (Micro-sample version) 340 - 2,000 nm |
| Spectralon® | Spectralon® | $BaSO_4$ | Spectralon® | $BaSO_4$ |
| Spectralon® | Not used | $Al_2O_3$ | Spectralon® | Not used |
| 4 | 2 | 5 | 5 | 2 |
| 8° | No ports | 6° | 8° | No ports |
| 0° | No ports | 6° | 0° | No ports |
| ● | ● | Not available | ● | ● |
| ● | ● | ● | Not available | ● |
| ● | ● | ● | ● | ● |
| ● | Not available | ● | ● | ● |
| ● | Not available | ● | ● | Not available |
| ● | ● | Not available | Not available | ● |

## Selecting a detector for the UH4150 main unit

- **UH4150 Integrating Sphere Detection System**
  A 60 mm integrating sphere needs to be purchased with the spectrophotometer to use for calibration and performance check.
- **UH4150 Direct Light Detection System**
  The direct light detector built in the spectrophotometer, is used for calibration and performance check.
  The direct light detector can be replaced with an optional integrating sphere detector.

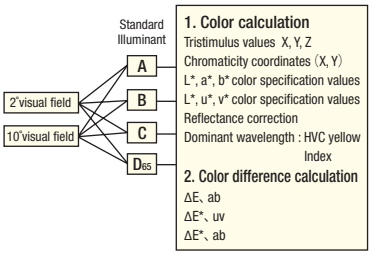
## Option Package Program*8

### Color Analysis

In color analysis, the Transmission or Reflectance spectrum of a sample in the range of 380 to 780 nm is used to calculate the tristimulus values (X, Y, Z), psychometric lightness values (L*, L), psychometric chroma coordinates (a*, b*, a, b, u*, v*), chromaticity coordinates (x, y), etc. The measurement is performed under specified color analysis parameters (viewing angle and light source). Users can specify the weight factor for light sources and can perform color analysis using a desired light source. Color Difference (ΔE*ab, ΔE*uv, ΔEab) is calculated either by selecting a measurement data file as the standard sample or by entering the tristimulus values (X, Y, Z).

#### Color Analysis Items

Tristimulus values X, Y, Z (JIS Z8701); chromaticity coordinates x, y (JIS Z8701); L*a*b* (JIS Z8729); L*u*v* (JIS Z8729); Hunter L,a,b; Munsell HV/C (JIS Z8721); psychometric chroma coordinates a*, b*, a, b, u*, v*; whiteness W (JIS Z8715); yellowness Y (I JIS K7105/JIS K7373); dominant wavelength λd (JIS Z8701); and excitation purity Pe (JIS Z8701)




### Optical Properties Measurement

Conforming to the best method for sheet glass transmittance and reflectance, specified in the JIS (Japanese Industrial Standards).

#### 1. Visible Transmittance (Reflectance) Measurement program

Spectral transmittance τv and spectral reflectance ρv of sheet glass are measured in the visible wavelength range. Using these measured values, visible light transmittance τv and visible light reflectance ρv based on relative luminous efficiency of CIE light adaptation are automatically calculated with respect to the standard light $D_{65}$ specified by CIE.
(CIE : Commission International ale de ℓ' Eclairage)

$$\tau v = \frac{\sum_{380}^{780} D\lambda \cdot V\lambda \cdot \tau(\lambda)}{\sum_{380}^{780} D\lambda \cdot V\lambda} \qquad \rho v = \frac{\sum_{380}^{780} D\lambda \cdot V\lambda \cdot \rho(\lambda)}{\sum_{380}^{780} D\lambda \cdot V\lambda}$$

Dλ : Spectral distribution of standard illuminant $D_{65}$
Vλ : Spectral luminous efficiency of CIE light adaptation
τ(λ) : Spectral transmittance (measured value)
ρ(λ) : Spectral reflectance (measured value)

#### 2. Solar Radiation Transmittance (Reflectance) Measurement Program

As for the radiant flux of that solar radiation incident on sheet glass, the transmitted radiant flux (reflected radiant flux) is measured, and solar radiation transmittance τe and solar radiation reflectance ρe are automatically calculated.

$$\tau e = \frac{\sum_{300}^{\Lambda} E\lambda \cdot \Delta\lambda \cdot \tau(\lambda)}{} \qquad \rho e = \frac{\sum_{300}^{\Lambda} E\lambda \cdot \Delta\lambda \cdot \rho(\lambda)}{}$$

τ(λ) : Spectral transmittance (measured value)
ρ(λ) : Spectral reflectance (measured value)
Eλ : Standard spectral distribution of directly irradiated relative solar radiation value
Λ : Highest wavelength of measurement (2,100 ≤ Λ ≤ 2,500)

#### 3. Sum-of-Products Calculation Program

The above-mentioned visible light transmittance (reflectance) and solar radiation transmittance (reflectance) conform to JIS R 3106. This program is formulated as a general form for calculation of these values. For each wavelength, a measured value is multiplied by coefficient τ(λ), and a total sum value is determined for normalization. A weight factor α (λ), wavelength range, and normalization factor can be set up arbitrarily in use of this program.

$$S = \frac{\sum_{\lambda_1}^{\lambda_2} \alpha(\lambda) \cdot \tau(\lambda)}{\sum_{\lambda_1}^{\lambda_2} \alpha(\lambda)} = \frac{1}{K} \sum_{\lambda_1}^{\lambda_2} \alpha(\lambda) \cdot \tau(\lambda)$$

Where, $K = \sum_{\lambda_1}^{\lambda_2} \alpha(\lambda)$

#### 4. Weight Factor Input Program

With this program, a correction value (weight factor) for each wavelength interval Δλ can be input in a wavelength range of $\lambda_1$ to $\lambda_2$. Using the input values, the sum-of-products program is carried out.
Up to five wavelength intervals can be assigned individually, and up to 500 data points can be specified.

#### 5. Spectrum Correction Program

A photometric value at each wavelength is multiplied by correction coefficient Ro (λ), and the result of multiplication is displayed and recorded in graph.
A correction count value can be specified arbitrarily by the user. This program is particularly useful for absolute reflectance spectral measurement.

R(λ)=r(λ)・Ro(λ)
R (λ) : Corrected data
r (λ) : Measured data (%)
Ro (λ) : Correction coefficient data

#### 6. Correction Coefficient Input Program

This program is designed for input of correction coefficient data. Up to 500 points can be specified.

#### 7. Film Thickness Calculation Program

The measured interference spectrum is used to calculate the thickness of monolayer film material. The parameters of the incident angle and the refractive index of the film must be specified. Further, by specifying a reference film thickness, it is possible to calculate the difference between the measured film thickness and the reference film thickness.

$$d = \frac{N-1}{2\sqrt{n^2 - \sin^2\theta}} \times \frac{1}{\frac{1}{\lambda_1} - \frac{1}{\lambda_2}} \times 10^{-3}$$

d : Film thickness (μm)···value to be calculated
N : Number of interference peaks···Counted automatically
n : Reflection factor···Manually entered value
θ : Angle of incidence···Manually entered value
$\lambda_1$ : First peak wavelength in spectrum (nm)
$\lambda_2$ : Last peak wavelength in spectrum (nm)

#### 8. Reflectance of solar radiation (Paint)*

Calculation method of reflectance of solar radiation is in accordance with JIS K5602 (2008). This program allows measurement of reflectance of all wavelengths required by JIS K5602 (2008).
The wavelength range for calculation can be selected from three ranges (Whole wavelength : 300 - 2,500 nm, UV-VIS : 300 - 780 nm or NIR : 780 - 2,500 nm). Furthermore, this program determine the quality using the reflectance of solar radiation and lightness value (L* value) in accordance with JIS K5602 (2008).

* This program is available using the Option Package Program P/N 1J1-0211 for UV Solutions Program ver.4.2.

### Report Generator Program*8

Users can generate reports of measurement results in the format that they desire by making use of Microsoft® Excel®. The Report Generator Program allows the user to specify graph position and size. The user can create a wide variety of templates, such as customized reports, include tables, graphs, and desired calculations. (Microsoft® Excel®, which is not included as standard, is required to use the Report Generator Program.)

* 8 Please ask your dealer the suitable part number for UV Solutions program controlling your UH4150 or U-4100 main unit.



CAUTION: For correct operation, follow the instruction manual when using the instrument.

Specifications in this catalog are subject to change with or without notice, as Hitachi High-Technologies Corporation continues to develop the latest technologies and products for our customers.

NOTICE: The system is For Research Use Only, and is not intended for any animal or human therapeutic or diagnostic use.


**Hitachi High-Technologies Corporation**

**Tokyo, Japan**
**www.hitachi-hitec.com/global/science/**
24-14, Nishi-shimbashi 1-chome, Minato-ku Tokyo 105-8717, Japan

*For technical consultation before purchase, please contact:*
*contact@nst.hitachi-hitec.com*





Printed in Japan (H) **HTB-E101** 2013.8