

Spectroscopic camera for quantified colour inspection



Enable automation of human-dependent colour inspection

In the colour inspection process at the manufacturing site, both quality and stability are required. Epson's spectroscopic cameras have the ability to distinguish subtle colour differences that are difficult to distinguish with RGB cameras. Additionally their small size makes it possible to install them inline with existing production lines. Epson's spectroscopic cameras are now available to automate colour inspection.

Issues of Colour Inspection

In most cases, colour-related inspections are performed visually.

In addition to visual inspections, spot inspections using spectrophotometers are combined.

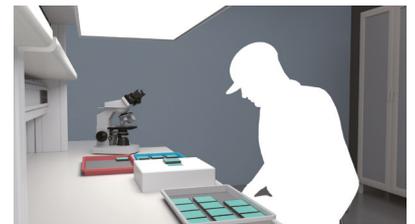
These inspections have the following issues:

Issues of visual inspection

Visual inspection has a number of issues, such as the need to rely on a specific technician, variation in inspection results depending on the surrounding environment, and the inability to quantify inspection results. There are also issues such as the time required to train inspection technicians, variation in judgment among technicians, and changes in judgment standards in the morning and evening due to technician fatigue.

Issues of spectrophotometer

Each spectrophotometer has a fixed measurement area (spot diameter), making it impossible to inspect colours in areas smaller than the spot diameter or large surfaces at once. When inspecting the colour of a large surface, multiple points of fixed spot diameter will need to be measured. The colour of the entire surface cannot be measured at once. The more points that are measured, the more time is required.





Spectroscopic camera SV-700S

Difference between spectrophotometer and spectroscopic camera

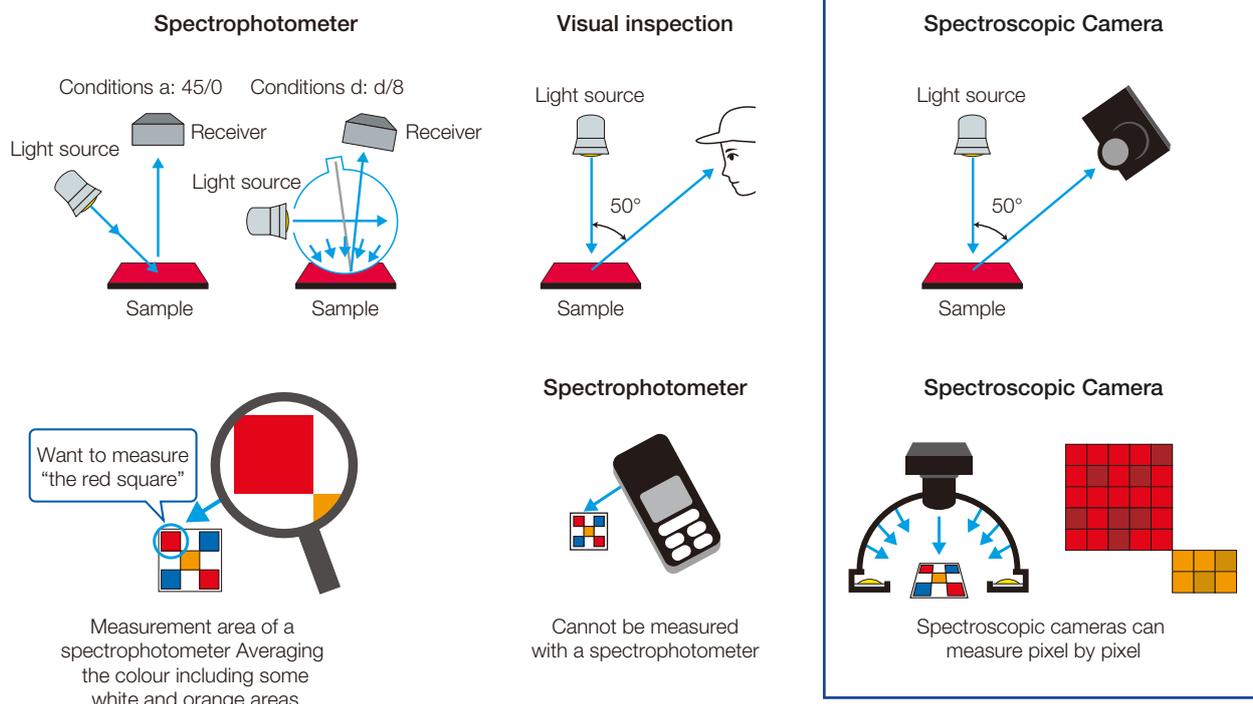
Correlation with visual inspection

Since the spectrophotometer must meet the colour measurement standards (ISO13655), the arrangement of the light source and the receiver is decided. Therefore, unlike the measurement environment for visual inspection, it is difficult to correlate the data from the spectrophotometer with the visual inspection results. On the other hand, the spectroscopic camera makes it easy to create the same measurement environment as visual inspection, making it easy to correlate inspection results.

Differences in micro measurement

Since the minimum spot diameter of the spectrophotometer is fixed, it is difficult to make micro measurements. The spectroscopic camera obtains measurement results on a pixel-by-pixel basis making it possible to acquire spectral information in a small area.

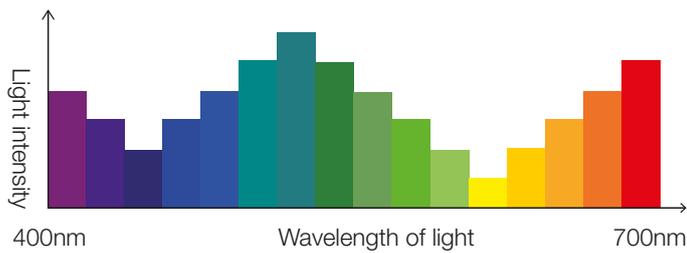
Photographs of spectroscopic cameras in this catalogue, including those on the cover, are equipped with optional lenses.



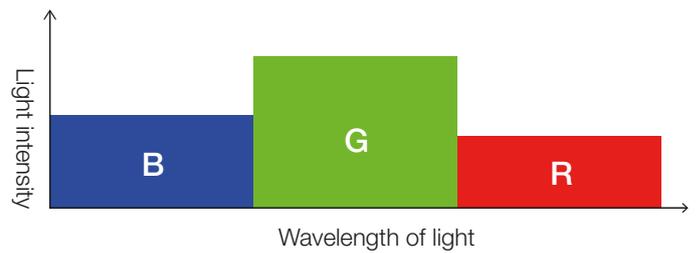
Spectroscopic camera vs RGB camera

The RGB camera acquires wavelength information in 3 bands of visible light region. Epson's spectroscopic cameras, on the other hand, acquire spectral information in 16 bands of colour. This makes the colour gamut and number of colours that a spectroscopic camera can represent superior to that of an RGB camera. Epson's spectroscopic camera can capture subtle colour differences that are difficult to capture with an RGB camera.

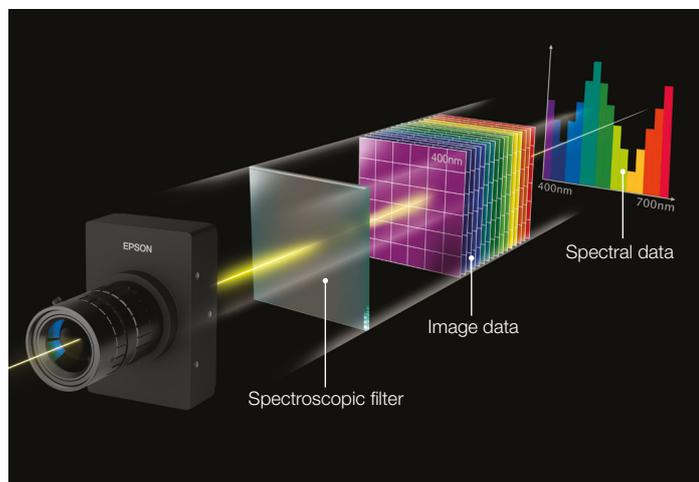
Spectroscopic camera



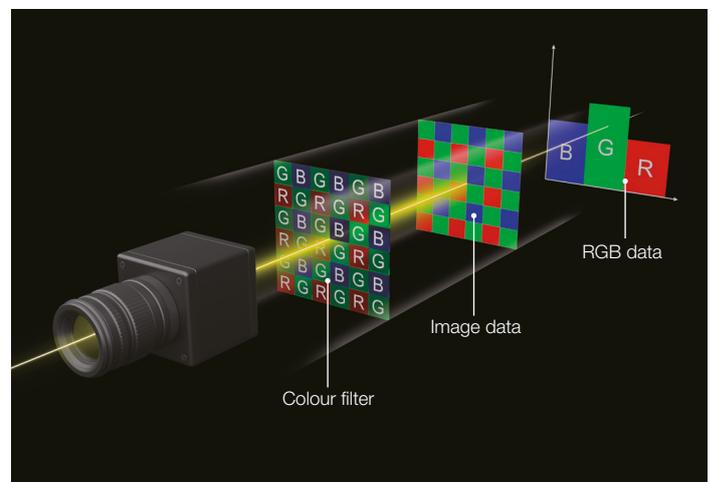
RGB camera



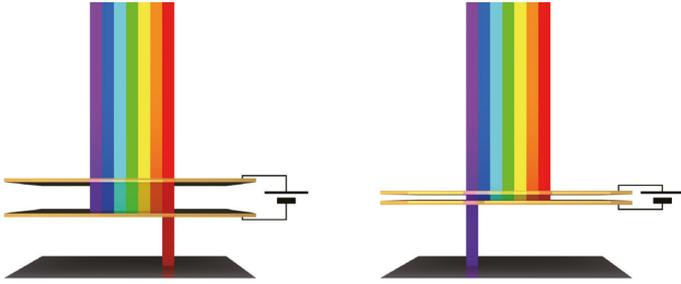
Spectroscopic camera



RGB camera



Mechanism and features of spectroscopic camera



MEMS Fabry-Perot Tunable Filter

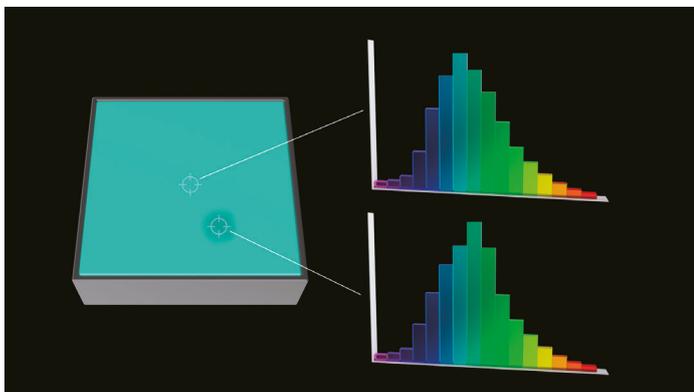
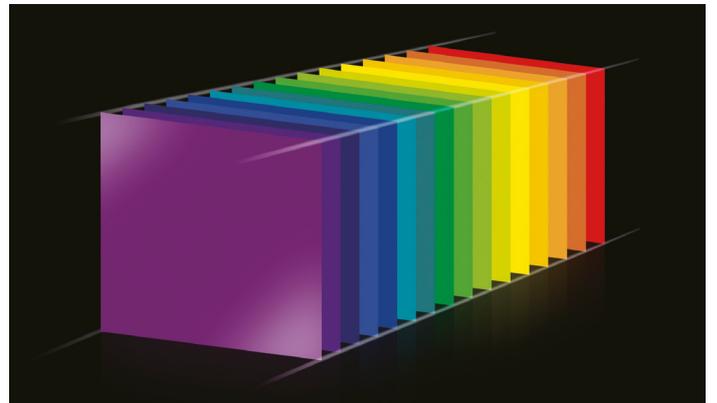
It is Epson's original compact spectroscopic device that uses MEMS technology to realize a Fabry-Perot interferometer*1. Epson's unique MEMS technology integrates the interference filter and actuator to achieve a compact, thin design and high-precision, high-speed operation.

*1 Fabry-Perot Interferometer: An interference filter that utilizes the interference of light generated by two parallel reflecting surfaces. By changing the distance between the reflecting surfaces, the wavelength of the transmitted light can be changed.

High-speed acquisition of 16-wavelength data in the visible light range

It is possible to acquire spectral data at high speed*2 for 16 wavelengths in the visible light range (400-700nm) for the entire specified area. Subtle colour differences that are difficult to capture with an RGB camera and are easily missed by human judges can be captured at high speed for pass / fail judgment.

*2 Colour measurement processing time: Approx. 2 to 4 seconds. Depends on the measurement target and lighting environment.

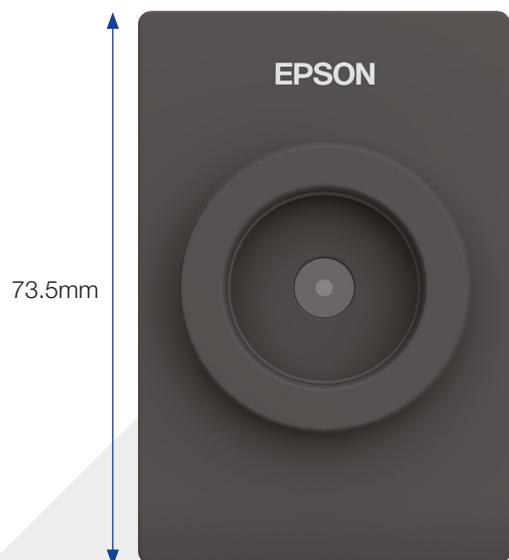


Area scan to enable acquisition of spectral information on a surface

Acquire spectral information of arbitrarily specified surfaces at once. This makes it possible to capture colour irregularities within a surface, which is difficult to inspect with a spectrophotometer. There is no need to transport and image an object, such as with a line scan camera.

Compact and lightweight size

With dimensions as small and lightweight as an RGB camera and can be installed almost anywhere. It is possible to replace the RGB camera and add an inspection stage to the production line.



A versatile vision system

Solves problems associated with visual inspection and spectrophotometers

Area scan spectroscopy

It is possible to measure the colour of a specified area in batch, just as if you were looking at it visually.

There is no need to transport the object and capture images as with a line scan camera.

High speed switching 16 bands

It has a wider colour range than RGB cameras and can distinguish subtle colour differences that are difficult to distinguish with RGB cameras.

It measures colours by rapidly switching between 16 bands in the visible light range (400-700nm).

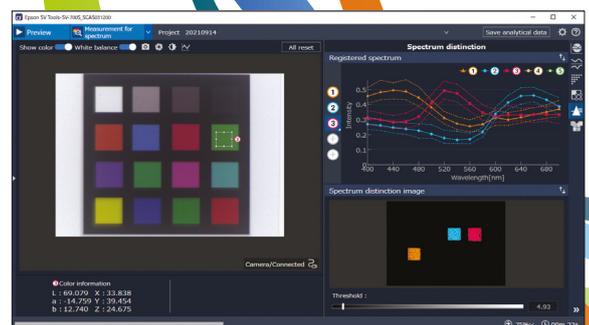
Compact and lightweight

It is as small and light as an RGB camera and can be installed almost anywhere, replacing an RGB camera or adding an inspection stage to a production line. It can also be easily installed in a colour inspection room.

Two types of inspection software: Supporting offline and inline inspection applications

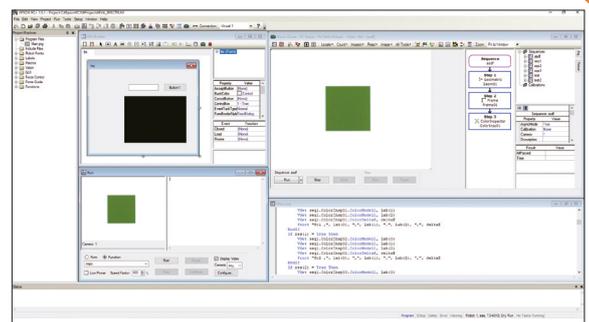
Spectroscopic Vision Tools

Easy no code programming software specializing in colour inspection for offline applications.



Vision Guide

Equipped with image processing functions and can be programmed to build a variety of colour inspection applications that are part of inline automation applications.



Easy integration with Epson robots

The system can be combined with Epson robots.

Colour inspection and robot operation can be programmed together on the inline software.



Spectroscopic Vision Controller



Easy to use vision tools

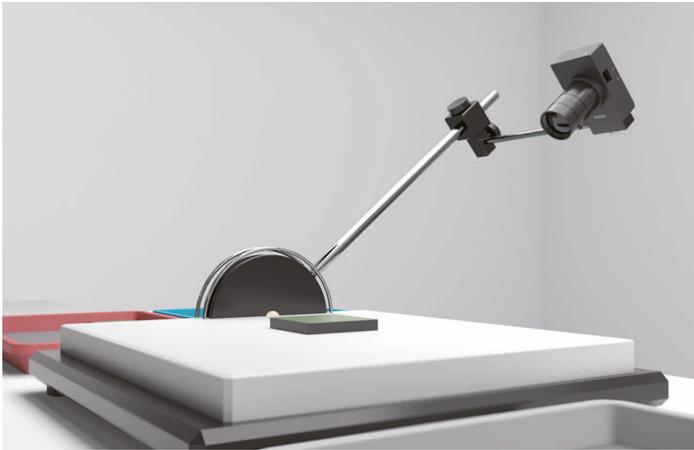
Software for offline operation

Spectral images can be easily acquired by operating the mouse. It provides spectroscopic measurement and various analysis functions with simple operation.

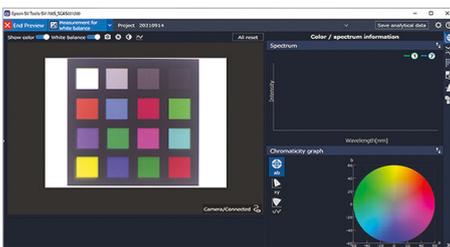
It is possible to register the colour master data and make a pass / fail judgment based on the colour difference from the inspection target.

Various functions enable quantification and visualisation of various colour-related inspections.

It can also be used for colour inspection verification work prior to programming with inline software.

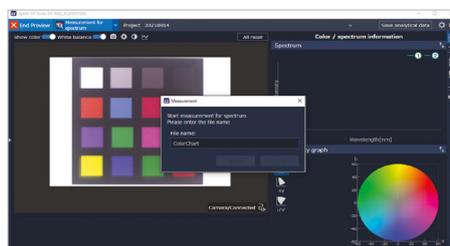


Measurement function



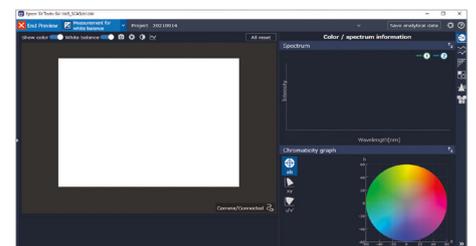
Preview

Real-time images captured by the spectroscopic camera can be displayed.



Spectrum measurements

System can measure the reflectance, transmittance, and spectrum of the luminous material at each pixel.

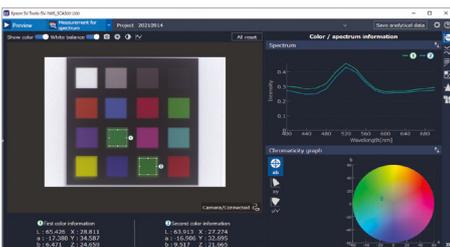


White balance

The reference image can be measured to standardise the reflectance or transmittance and reduce lens shading and lighting irregularities.

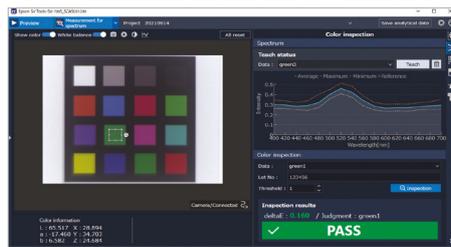


Analysis function



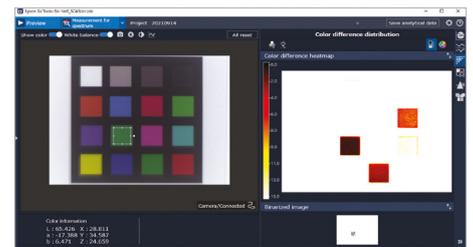
Colour / spectrum information

Colour information can be visualized and quantified on the spectral waveform and Lab colour space.



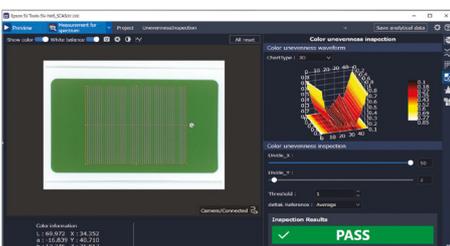
Colour inspection

System can judge pass / fail based on the colour difference from the registered data.



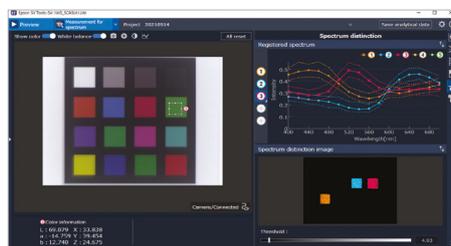
Colour difference distribution

Visualises the magnitude of colour difference per pixel. Microscopic colour irregularity inspection is possible.



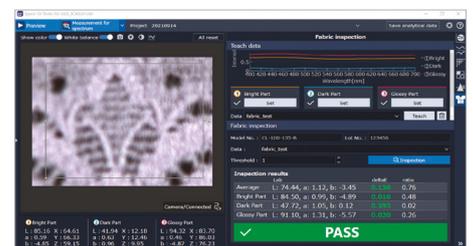
Colour variability inspection

The inspection area can be divided into matrices for macroscopic inspection of colour irregularities.



Spectrum distinction

Based on the registered spectrum data group, it is possible to determine whether the spectra match on a pixel-by-pixel basis by the spectral shape.



Fabric inspection

Colour inspection can be performed by removing unnecessary backgrounds such as shadows due to weaving fibres.

Epson RC+7.0 / Vision Guide 7.0

Software for inline operation

The inline software is provided by integrating the image processing function Vision Guide 7.0 with the program development software Epson RC+7.0.

Various colour inspection functions are available in this software. With this programming environment, you can freely build applications using the spectroscopic camera.

Epson RC+7.0 is used to develop robotic automation, making it possible to program robots, image processing, and colour inspection functions together in a single development environment.

*The object must be stationary during imaging.

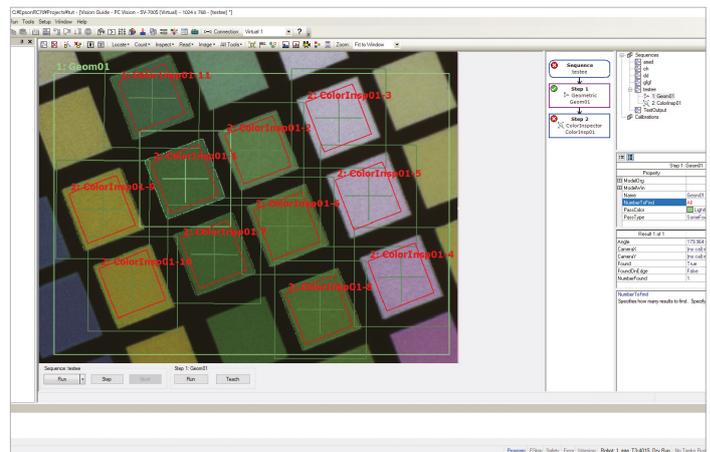
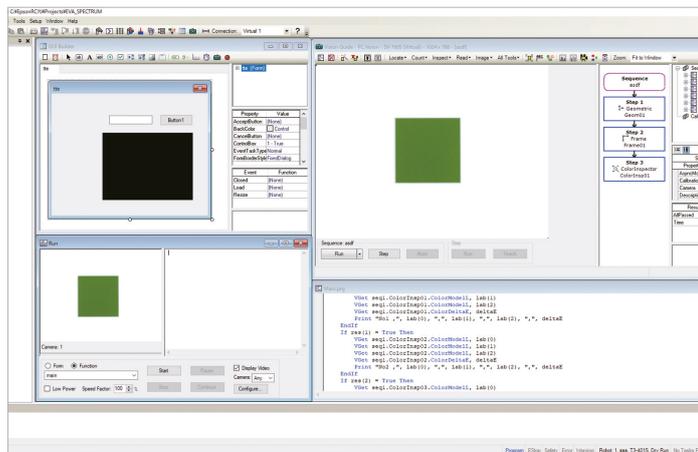
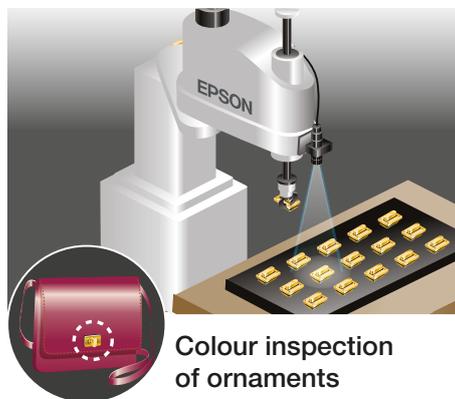


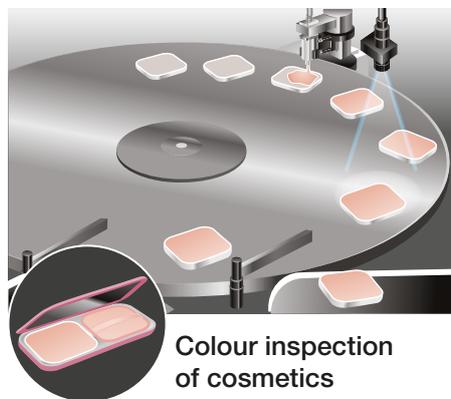
Image processing example:
The shape of the colour patch can be recognised and the colour inspection of only that part can be performed.

Usage examples



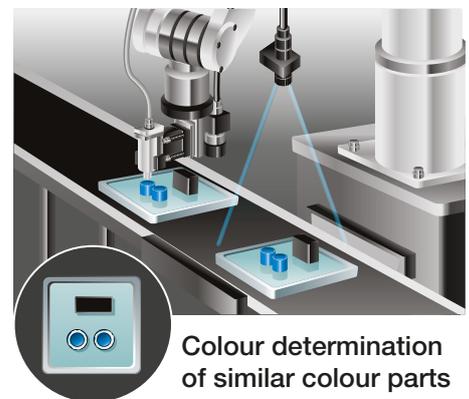
Colour inspection of ornaments

Inspect whether the paint or rust preventive is properly applied to decorative hardware on bags and other items.



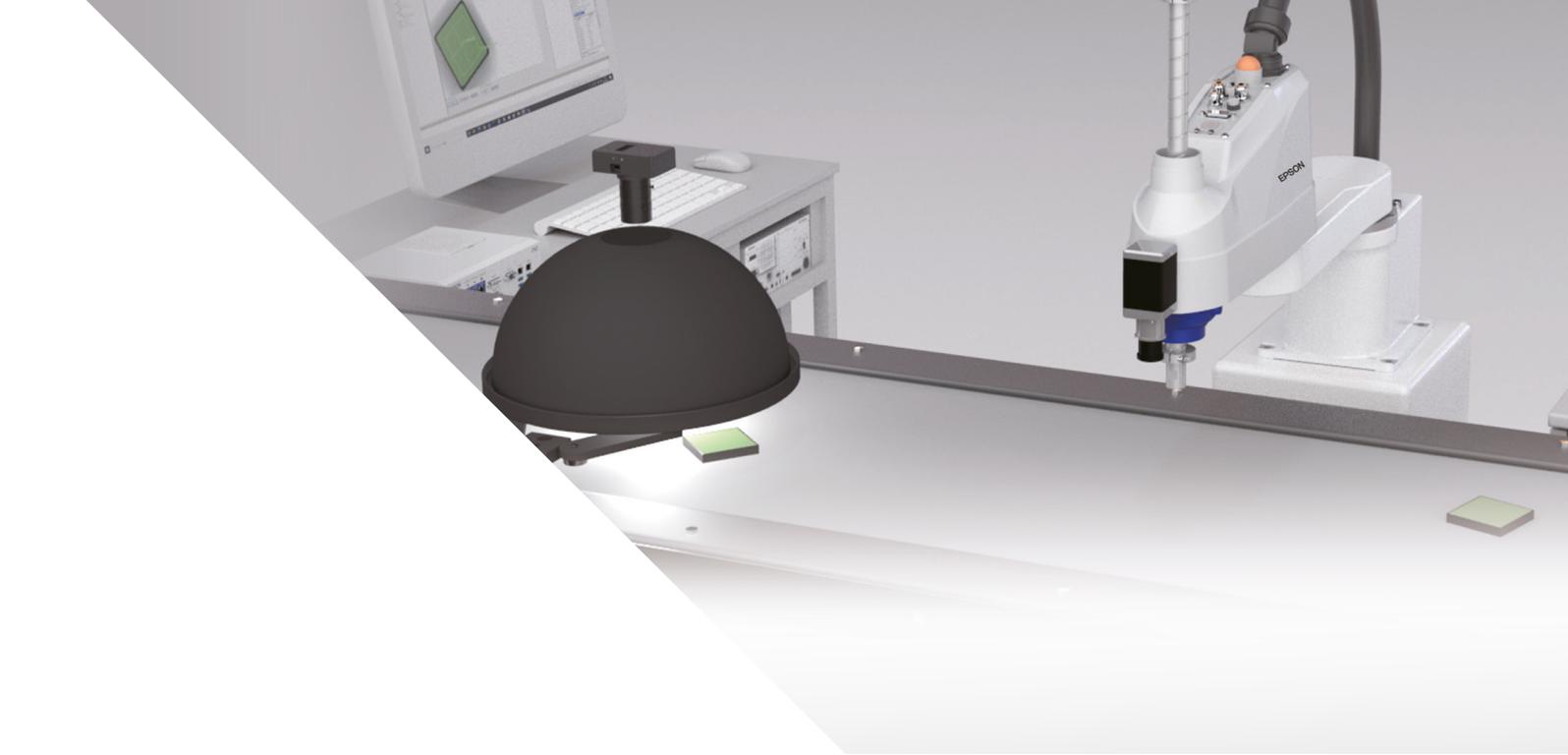
Colour inspection of cosmetics

Inspect whether the colour of the product is stable after the foundation is filled.

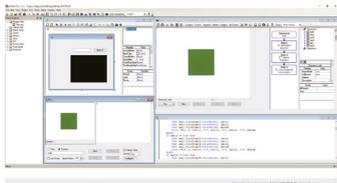


Colour determination of similar colour parts

It recognises two identical parts on the tray and inspects if their colour is within a defined threshold.



System configuration



Software



Spectroscopic Vision Controller



Robot



Spectroscopic Camera



Monochrome / colour camera



PLC (Programmable logic controller)



Spectroscopic camera setup

Line-up		Integrated set SV-700S-CVIO	Offline set SV-700S-CVO	Inline set SV-700S-CVI	Offline software SV-Software_O	Inline software SV-Software_I
Spectroscopic Camera	SV-700S	•	•	•	–	–
Spectroscopic Vision Controller	CV2-SV	•	•	•	–	–
Offline software	Epson Spectroscopic Vision Tools	•	•	–	•	–
Inline software	EPSON RC+7.0 / Vision Guide 7.0	•	–	•	–	•

Set contents

Integrated set	Using offline software, you can perform preliminary verification of colour inspection without programming. In addition, the inline software allows you to freely program the colour inspection application you want to achieve and link it to other devices.
Offline set	Offline software package allows you to easily perform point and click colour inspections. There is no programming function, and colour inspection is performed only with the installed function.
Inline set	This package can be selected when verification work using offline software is not required, such as repeat manufacturing of inline equipment.
Offline software	Offline software can be added to the inline set later. The product configuration is equivalent to the integrated set. *Install this software on the spectroscopic vision controller. The software cannot be used alone.
Inline software	Inline software can be added to the offline set later. The product configuration is equivalent to the integrated set. *Install this software on the spectroscopic vision controller. The software cannot be used alone.

Options

Lens	Various C-mount lenses are available. We recommend using the spectroscopic camera in combination with a megapixel lens (HF).
Tripod adapter	An adapter for attaching a spectroscopic camera to a general tripod (1/4-20UNC standard).
AC adapter	The power supply (24VDC) for the Spectroscopic Vision Controller CV2-SV will be prepared by the customer. This option is an adapter for converting AC power (100-240V) to DC24V. When using this option, the power plug cable that matches the shape of the power outlet will be prepared by the customer.
GUI Builder 7.0	You can create a GUI (Graphical User Interface) on Epson RC+7.0.

Precautions for selection

- 1 It is necessary to select a C-mount lens with an appropriate viewing angle and viewing size depending on the object.
- 2 It is necessary to select the appropriate lighting according to the object to be measured and its surface condition.
- 3 It is necessary to have a blackout curtain that can maintain an enclosed environment that is less affected by ambient light.
- 4 Prepare an LCD monitor with a resolution of 1,280 x 1,080 or higher.

Precautions for use

- 1 Please use the attached cable between the spectroscopic camera and the spectroscopic vision controller. Also, USB hubs cannot be used.
- 2 It is recommended that the white balance be checked periodically.
- 3 It is recommended to warm up the unit to ensure stable operation.
(Please take into account the time it takes for the lighting to stabilise.)
- 4 There are individual differences and some in-plane variations in cameras.

Customer preparation

The lens, lighting, camera mount (tripod), blackout curtain, keyboard, mouse, and LCD monitor will be prepared by the customer.



Lens



Light



Camera mount



Blackout curtain



Keyboard



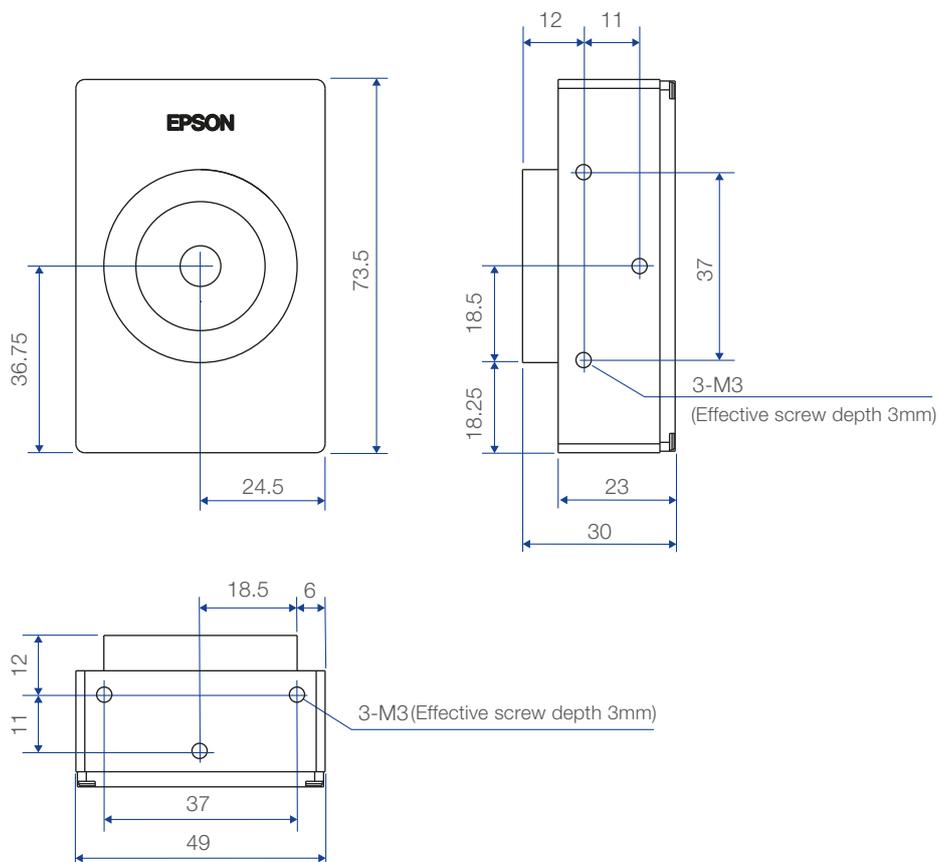
Mouse



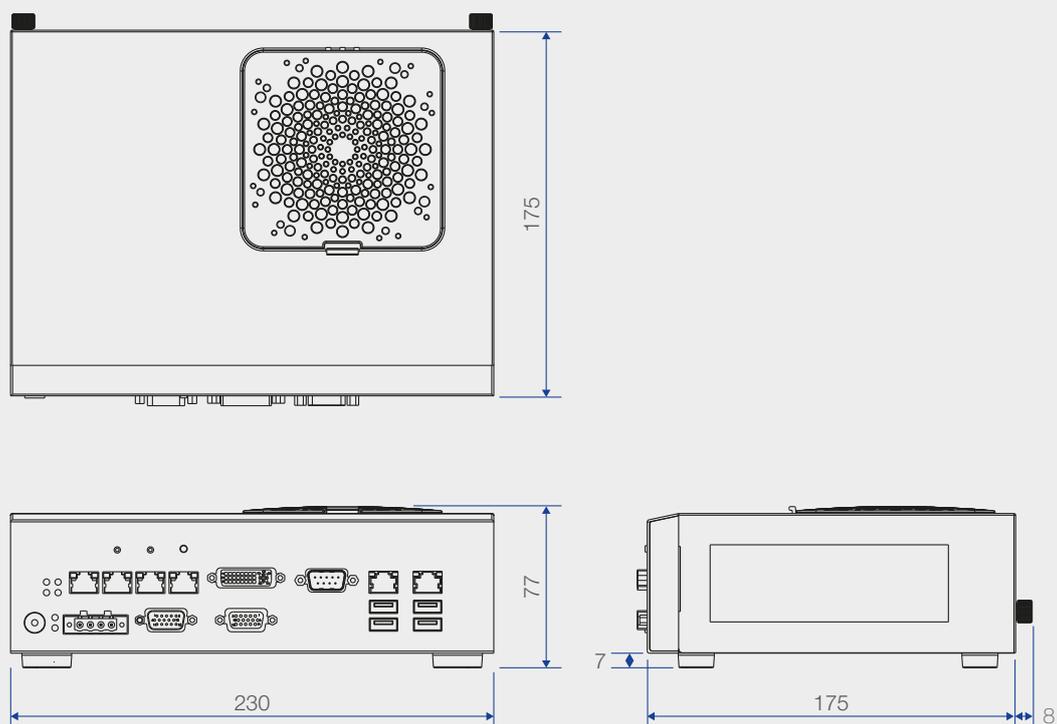
LCD Monitor

External dimensions

Spectroscopic Camera SV-700S



Spectroscopic Vision Controller CV2-SV



Specifications

Spectroscopic Camera	
Model name	SV-700S
Spectral range	400 - 700 nm
Spectral bands	16 bands
Spectral bandwidth	20 nm
Spectral resolution	45 nm (Half width, Representative value)
Spatial resolution	QVGA (320x240), VGA (640x480), XGA (1,024x768)
Pixel size	1.67 x 1.67 μ m
Effective pixel area	1.71 x 1.28 mm
Shutter	Rolling
Lens mount	C mount
Dimensions	30 x 49 x 73.5 mm
Weight	175 g
Camera cables	Flex resistance 3 m (x 2, Bundle)

Spectroscopic Vision Controller	
Model name	CV2-SV
Number of connectable cameras	1 spectroscopic camera 4 GigE cameras (Only when using Epson RC+7.0. Only available for cameras specified by Epson.)
Supply voltage	DC 19 - 24 V
Rated current	11.57 A (at DC19 V) to 9.16 A (at DC24 V) or less
Weight	2.1 kg

Common specifications	
Operating temperature	+5 - +40 °C
Ambient relative humidity	20 - 80 % (No condensation)

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