

OPTICAL PINHOLE INSPECTION UNITS



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Finds small holes in various materials and products.

Recently, material and product inspection is becoming more and more important in all kinds of manufacturing processes. Hamamatsu optical pinhole inspection units find tiny holes, flaws, to help manufacturers improve their product quality and reliability. Besides detecting those defects, our optical pinhole inspection units can also monitor drilling processes, etc.

Problems caused by pinholes

Liquid leaks

Quality degradation

Deformation and tears

Corrosion

Change in electrical characteristics

Contamination from foreign matter

Poor appearance

What can it see?

[Material/applications]

Accommodates a wide range of materials and products

Component and material examples

Metal materials



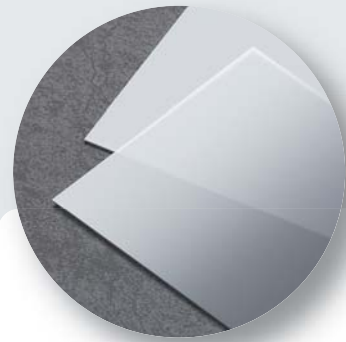
Metal material examples
Stainless steels, titanium, aluminum

Paper and nonwoven fabric



Paper and nonwoven fabric material examples
Paper, milk cartons, masks, fabric

Semi-transparent materials



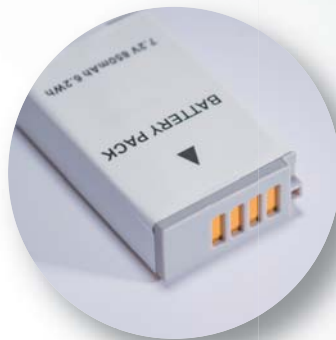
Semi-transparent material examples
Polyethylene, ceramic, teflon

Sealed and molded product examples

Beverage cans and can lids



Aluminum battery pack



Aluminum blister pack



How does it differ from others?

[Comparison with other methods]

High speed and high detection capability

Internal high-sensitivity detector* ensures high speed and high sensitivity inspections.

Non-contact inspection

Objects under inspection are not exposed to any stress caused by liquid pressure or to any particular environment such as electric fields, magnetic fields, and electrolytic solutions.




Low running cost

Semi-automatic monitoring with no human intervention allows cost reductions.

* Used detector is a photomultiplier tube or semiconductor photosensor we made in-house.

Hamamatsu optical pinhole inspection units also offer the following features:

- **Self-diagnostic function**
Checks detector operation to allow high-reliability inspections.
- **Excess light protection circuit included**
Minimizes damage to detector even when exposed to excess light.

	Hamamatsu optical pinhole inspection units 	Visual inspection 	Camera inspection 
Detection capability	Excellent High detection capability	Poor	Good
Type of workpiece for inspection	Good Accommodates a wide range of workpieces	Poor	Good
Production line speed	Excellent Accommodates high-speed conveyors	Poor	Average
Contact / non-contact	Excellent Non-contact inspection	Poor	Excellent
Size of workpiece for inspection	Good Accommodates a wide range of sizes	Good	Average
Initial cost	Average Initial cost required for installing inspection unit	Good	Poor
Running cost	Good Only power costs are required	Poor	Average
Position and size judgment	Poor Basically impossible	Average	Excellent

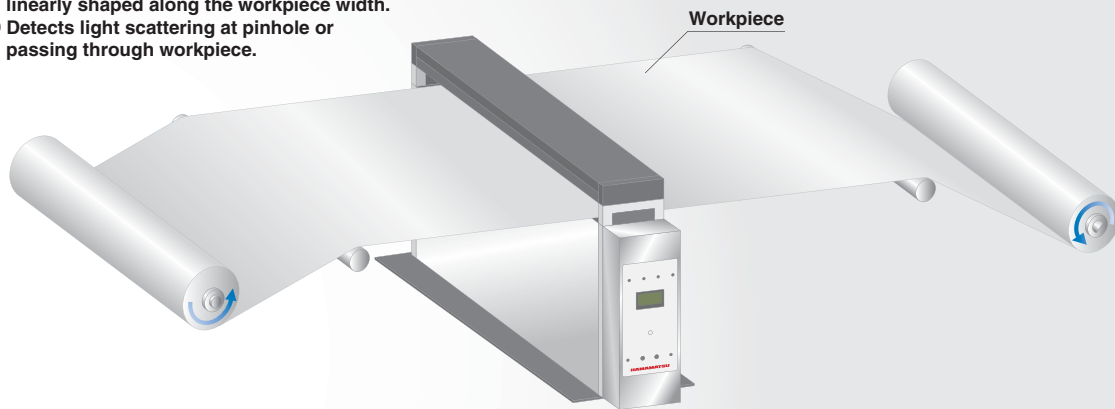
How does it work?

[Detection principle]

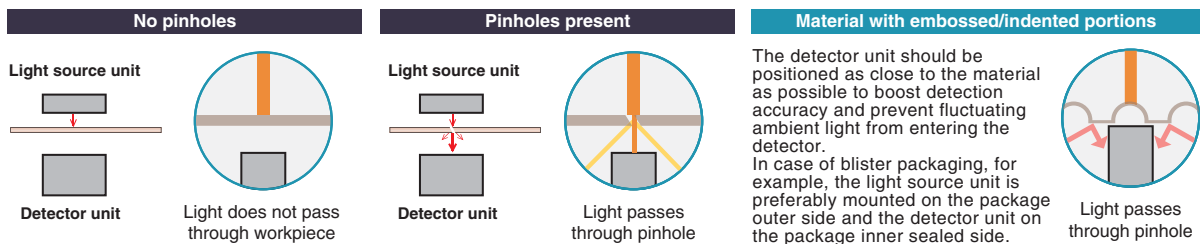
● Pinhole judgment

Hamamatsu optical pinhole inspection units allow setting the pinhole judgement threshold to any desired level. Inspection units judge light exceeding the threshold level as a pinhole.

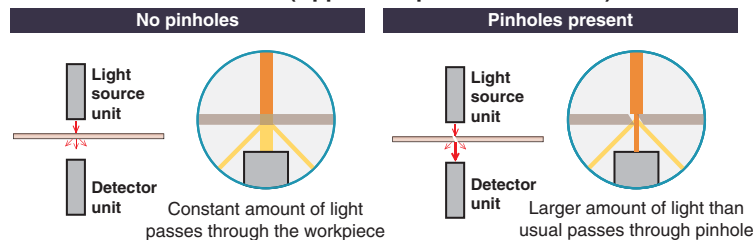
- ① Irradiates workpiece with light that is linearly shaped along the workpiece width.
- ② Detects light scattering at pinhole or passing through workpiece.



[Light impervious material] Detecting light that passes through a pinhole

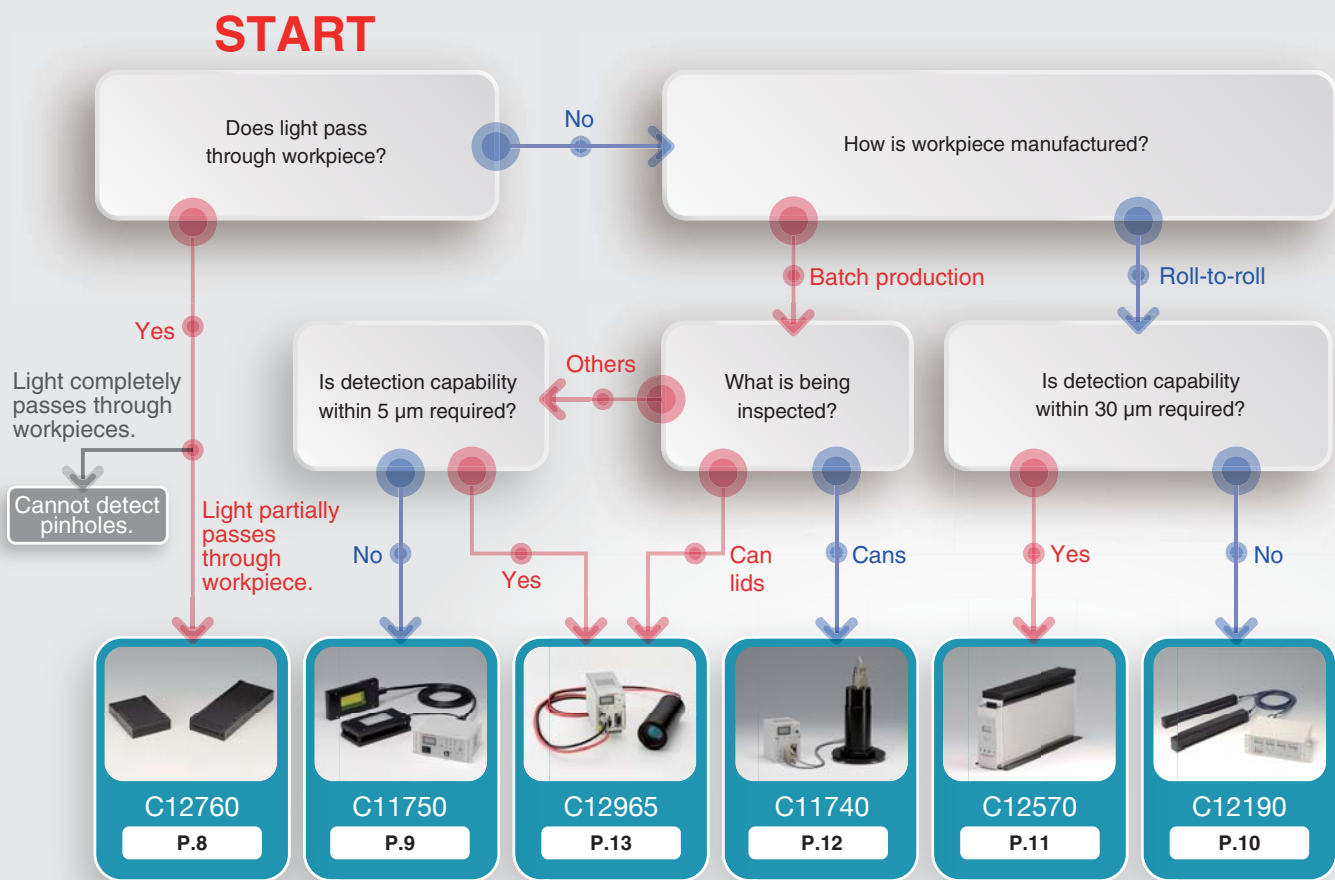


[Semi-transparent material] Detecting light that passes through a pinhole (Applicable products: C12760)



How to select

[Flowchart for selecting an optimal unit]



Detection capability (Unit: μm)

		0.1	1	10	100
Pinhole image		.	•	●	●
Type No.	C12965	~Φ1*			
	C12570		Φ2~		
	C11750		Φ5~		
	C11740			Φ10~	
	C12190				Φ30~
	C12760			Φ10~	

* Detection capability is evaluated using our standard optical pinhole. However, when evaluating the detection capability for finding pinholes smaller than 1 μm, the light level is reduced according to the pinhole size.

C12760

Minimum detectable pinhole size
10 μm

Detection width (per unit)
50.8 mm

Maximum detection speed
600 m/min

Highly versatile and even compatible with semi-transparent workpieces
Compact design allowing parallel multi-unit operation

Parameter	Description / Value	Unit	
Input voltage (DC)	24	V	
Detection unit	Sensor	Photodiode array	
	Maximum current consumption	0.1	A
	Detection width	50.8	mm
Light source unit	Light source / Wavelength	Laser diode / 660	nm
	Maximum current consumption	0.1	mA
	Maximum energy output	5	mW
	Laser class	3R (IEC60825-1)	—
Operating temperature range	+10 to +40	$^{\circ}\text{C}$	
Storage temperature range	0 to +50	$^{\circ}\text{C}$	
Operating / storage humidity range	35 to 85 (no condensation)	%RH	
Applicable standard	IEC61326-1: 2005 Group 1 Class A, IEC60825-1: 2007 Class 3R laser product	—	

CLASS 3R LASER

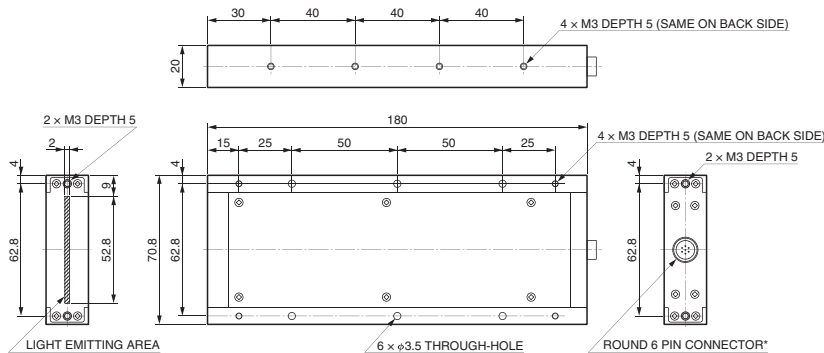
Invisible Laser Radiation: Avoid Direct Exposure of eyes to Beam

●The Laser emits invisible laser radiation. The instrument which used the LASER, operated under ordinary conditions, is classified as Class 3R according to the laser product classification code IEC 60825-1. See IEC 60825-1 for more details and safety operation concerning the above countermeasures.

* Accessories: Detection connector socket, light source connector socket

Dimensional outline (Unit: mm)

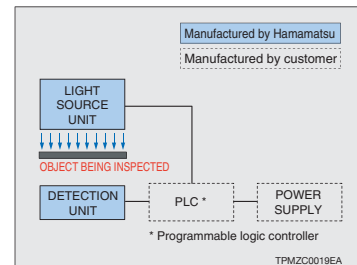
●Light source unit



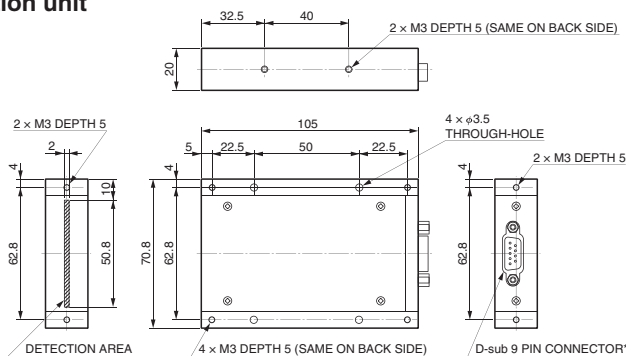
* C12760 includes a round 6 pin connector (HIROSE HR10A-7P-6P(73)). Please prepare a cable between connector and PLC because it is not attached with C12760.

Weight: 0.36 kg

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●Detection unit



* C12760 includes a D-sub 9 pin connector (OMRON XM3D-0921 and hood XM2S-0921). Please prepare a cable between connector and PLC because it is not attached with C12760.

Weight: 0.21 kg

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C11750



Minimum detectable pinhole size

5 μm

Inspection time

0.5 s or less

Detector unit can be customized to match your specific application
Compatible with large-area workpieces

Parameter		Description / Value	Unit
Input voltage (DC)		24	V
Maximum current consumption		0.5	A
Detection unit	Type No.	A12159-01 (sold separately) ^①	—
	Wavelength	470	nm
Light source unit	Type No.	L12057-01 (sold separately) ^①	—
	Operating temperature range	+10 to +45	$^{\circ}\text{C}$
Storage temperature range		-20 to +50	$^{\circ}\text{C}$
Operating / storage humidity range		35 to 85 (no condensation)	%RH
Applicable standard		IEC 61326-1 Group 1 Class A, IEC 61010-1	—

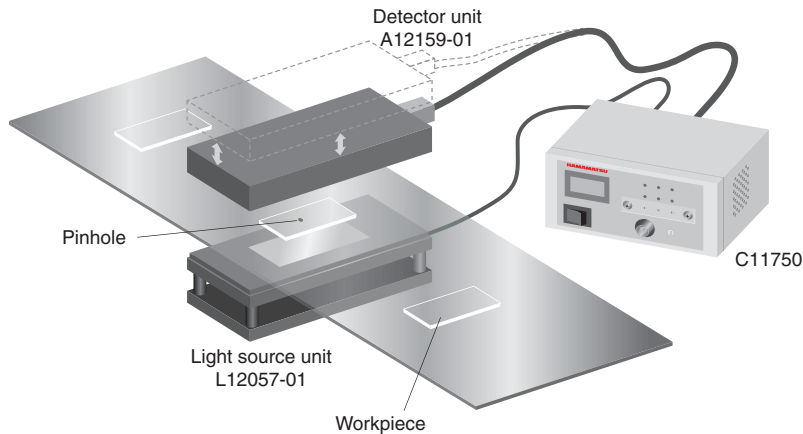
^①Detector unit can be customized to match your application.

*Detectable pinhole size depends on workpiece shape and equipment configuration. Please consult us if you need to detect pinhole sizes smaller than 5 μm .

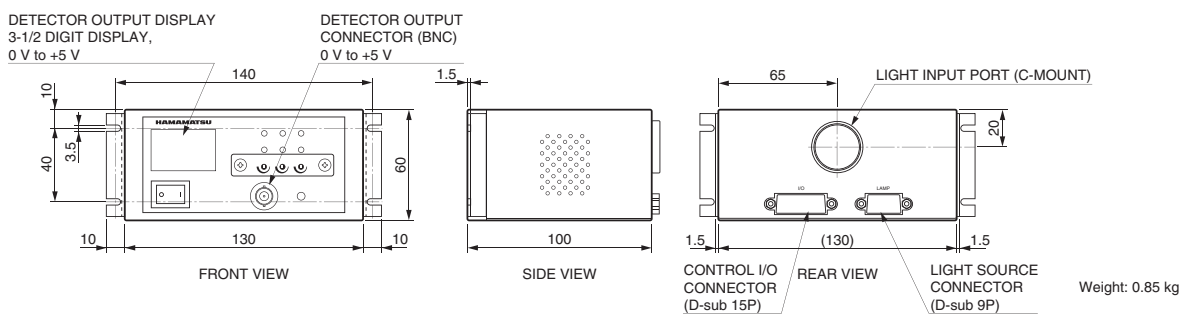
*Information on I/O socket connections and recommended operation flowchart is available.

*Accessories: I/O socket, light source socket

Detection configuration example



Dimensional outline (Unit: mm)



C12190



Minimum detectable pinhole size
30 μm

Detection width (per unit)
1828 mm

Maximum detection speed
600 m/min

Judges pinholes by grouping into 4 sizes
Sensitivity and detection width are selectable to match your application

Common specifications

Parameter		Description / Value	Unit
Input voltage (DC)		24	V
Detection unit	Sensor	Photodiode array	—
	Number of channels ^①	4	—
Operating temperature range		+10 to +40	°C
Storage temperature range		-20 to +50	°C
Operating / storage humidity range		35 to 85 (no condensation)	%RH
Applicable standard		IEC 61326-1 Group1 Class A	—

Standard type

Parameter		-01	-02	-03	-04	-05	-06	Unit
Detection pinhole size ^②		50 μm to 2 mm						—
Detection width		304.8	609.6	914.4	1219.2	1524	1828.8	mm
Detection unit ^③	Maximum current consumption	0.75	0.8	0.85	0.9	0.95	1	A
Light source unit	Light source / Wavelength (Typ.)	LED / 644						nm
	Maximum current consumption	0.18	0.36	0.54	0.72	0.9	1.08	A

High sensitivity type

Parameter		-11	-12	-13	-14	-15	-16	Unit
Detection pinhole size ^②		30 μm to 1 mm						—
Detection width		304.8	609.6	914.4	1219.2	1524	1828.8	mm
Detection unit ^③	Maximum current consumption	0.75	0.8	0.85	0.9	0.95	1	A
Light source unit	Light source / Wavelength (Typ.)	LED / 940						nm
	Maximum current consumption	0.3	0.6	0.9	1.2	1.5	1.8	A

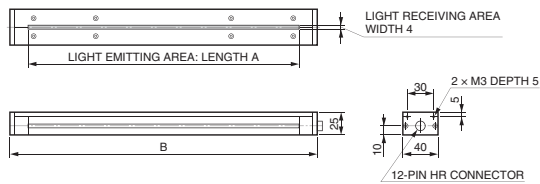
①Detection width is equally divided into each channel. ②Detection pinhole size depends on light intensity and installation environment.

③Values when used along with control unit.

* Accessories: Light source connection cable (10 m), detection cable (10 m), I/O socket, pinout connector, Light source power connector

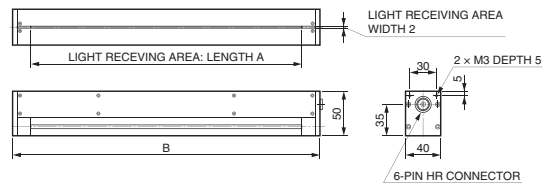
Dimensional outline (Unit: mm)

●Light source unit



	-1	-2	-3	-4	-5	-6	Unit
A	304.8	609.6	914.4	1219.2	1524.0	1828.8	mm
B	344.8	649.6	954.4	1259.2	1564.0	1868.8	mm
Weight	0.5	1.2	1.9	2.6	3.3	4	g

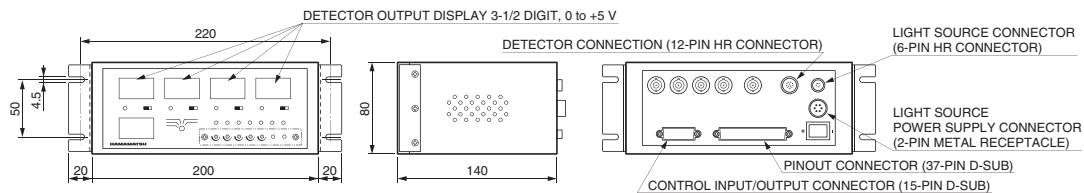
●Detection unit



	-1	-2	-3	-4	-5	-6	Unit
A	304.8	609.6	914.4	1219.2	1524.0	1828.8	mm
B	344.8	649.6	954.4	1259.2	1564.0	1868.8	mm
Weight	0.8	1.6	2.5	3.3	4.2	5	g

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●Control unit



WEIGHT: 1.0 kg

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C12570



Minimum detectable pinhole size

2 μm

Detection width (per unit)

450 mm

Maximum detection speed

30 m/min

High detection capability
Light source position and detection width are selectable to match your application

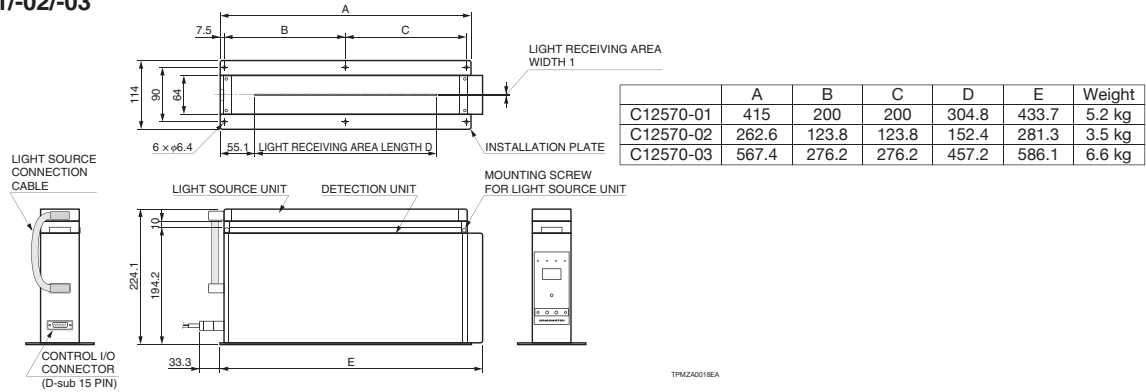
Parameter	Description / Value			Unit	
Suffix	-01/-11	-02/-12	-03/-13	—	
Input voltage (DC)	24			V	
Maximum current consumption	0.8			A	
Detection unit	Sensor	Photomultiplier tube		—	
	Detection width	300	150	450	mm
	Number of channel	2	1	2	—
Light source unit	Light source / Wavelength	LED/644		nm	
Operating temperature range	+10 to +40			$^{\circ}\text{C}$	
Storage temperature range	0 to +50			$^{\circ}\text{C}$	
Operating / storage humidity range	35 to 85 (no condensation)			%RH	
Applicable standard	IEC 61326-1 Group 1 Class A			—	

* Detection pinhole size depends on light intensity and installation environment.

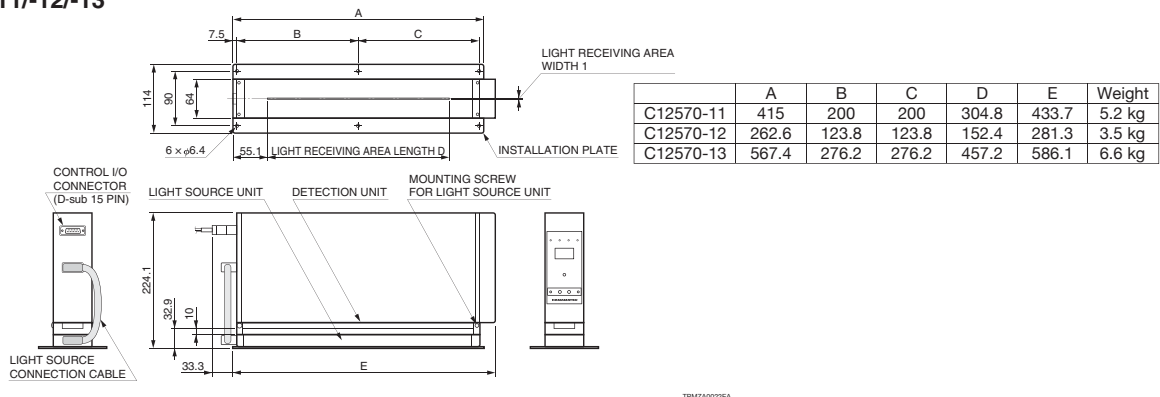
* Accessories: I/O socket, light source cable (0.3 m), pinhole plate, optical pinhole (2 μm dia.)

Dimensional outline (Unit: mm)

●C12570-01/-02/-03



●C12570-11/-12/-13



C11740

Minimum detectable pinhole size
10 μm

Maximum detection speed
2400 pieces /min

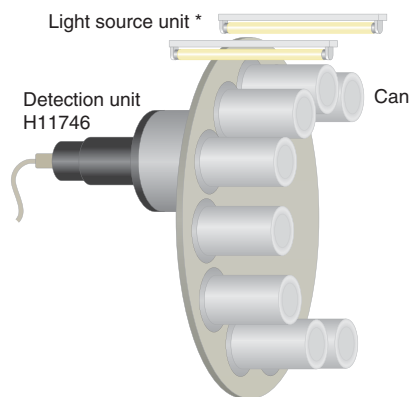
Designed specifically for inspection of cans
Can be used with equipment for inline inspections



Parameter	Description / Value	Unit
Input voltage (DC)	24	V
Maximum current consumption	0.5	A
Detection unit	Sensor	Photomultiplier tube
	Photosensitive area size	$\Phi 58$
	Wavelength range	450 to 480
Operating temperature range	+10 to +45	$^{\circ}\text{C}$
Storage temperature range	-20 to +50	$^{\circ}\text{C}$
Operating / storage humidity range	35 to 85 (no condensation)	%RH
Applicable standard	IEC 61326-1 Group1 Class A, IEC 61010-1	—

* Detectable pinhole size depends on can shape and irradiation light level.
* Accessories: Flange ring, I/O cable, PH300 cable, SCL cable

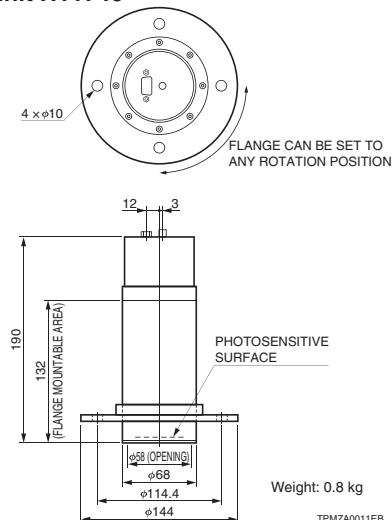
Detection configuration example



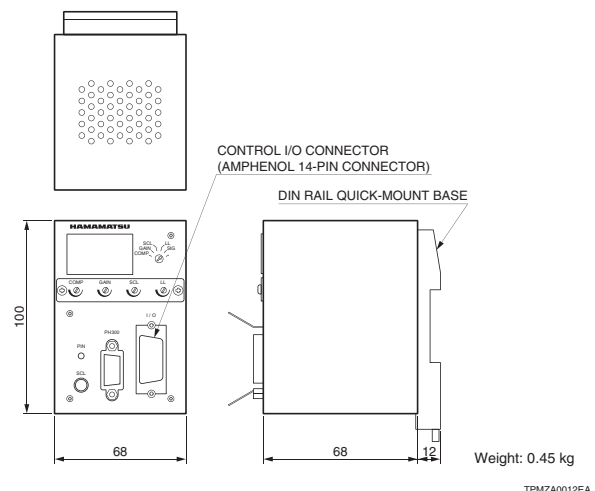
* Light source unit (L12533) is sold separately.

Dimensional outline (Unit: mm)

Detection unit H11746



Control unit C11747



C12965



Detectable
pinhole size
1 μm or less

Maximum
detection speed
600 pieces
/min

Designed specifically for micro pinhole inspection
of can lids and small items
Can be used with equipment for inline inspections

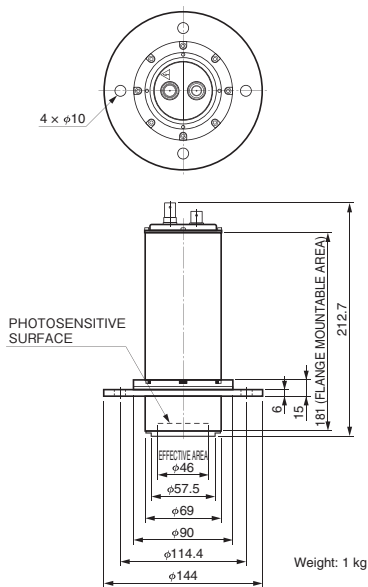
Parameter	Description / Value	Unit
Input voltage (DC)	24	V
Maximum current consumption ①	0.5	A
Detection unit	Sensor	Photomultiplier tube
	Photosensitive area size	$\Phi 46$
Operating temperature range	+10 to +40	$^{\circ}\text{C}$
Storage temperature range	0 to +50	$^{\circ}\text{C}$
Operating / storage humidity range	35 to 85 (no condensation)	%RH
Applicable standard	IEC 61326-1 Group1 Class A, IEC 61010-1	—

① Power consumption with no light source connected

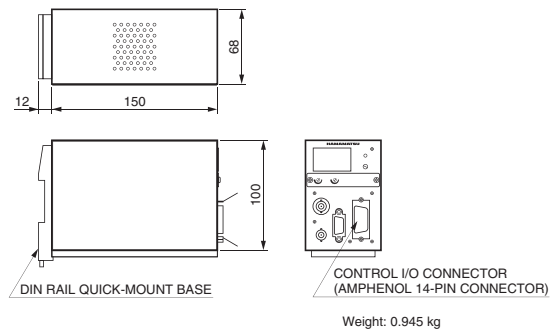
* Accessories: High voltage cable (2 m), signal cable (2 m), I/O cable (2 m), light source control cable (2 m)

Dimensional outline (Unit: mm)

Detection unit



Control unit



* Light source unit (Xenon flash lamp module L11316/L11317 series) is sold separately.

Q & A

Q Is it possible to find the pinhole positions, number of pinholes, and sizes?

A A single detector has only a limited detection range so cannot find the positions, number of pinholes, and sizes. However, if you use multiple detectors to cover different detection ranges, you can gain information on the approximate positions and number of pinholes.

Q Can you assess and evaluate workpiece samples?

A Yes, we can usually make evaluation tests of sheets, films, cans, can lids, molded parts, etc. Using one of our optical pinhole inspection units, we can assess, evaluate and issue a report of samples you send us. Though the exact turnaround time may vary according to the sample, making an evaluation usually takes about 2 weeks.

Q We want to use an optical pinhole inspection unit on production lines or inside equipment. How is it compatible with drive systems and control systems? Can it be installed and used in our current equipment?

A Basically, we ask that customers make the setups for the drive systems for the production lines and the control systems for the pinhole inspection unit. If you want to use our unit inside your current equipment or on your production line, then we will select the optimal product to match your line configuration. Please feel free to consult us.

Q Do optical pinhole inspection units have to be in a dark room to work properly?

A Our optical pinhole inspection units can operate in a room with normal lighting. However, in some cases, it may be necessary to block out ambient light around the detector depending on the type of product or usage method.

Q When you say “semi-transparent materials” what do you actually mean?

A At Hamamatsu Photonics, we use the term “semi-transparent materials” to refer to any materials that allow even a tiny amount of light to pass through them. The higher the transparency, the more difficult to detect pinholes. Some typical materials are listed on page 4, so please have a look at them.

Q Some workpieces we want to inspect are very long along their width. Can these be inspected also?

A Workpiece width compatible with our optical pinhole inspection units varies according to the product. See the following table.

Model No.	Compatible? (Yes/No)	Method
C12570	Yes	Use multiple units in a staggered arrangement
C12190	Yes	
C12760	Yes	
C11750	Yes	Use a customized design of light condensers and detectors to match the workpiece width
C11740	No	Unusable
C12965	No	

Q Are there any precaution to take when using with equipment?

A For example, if a film-like workpiece is to be inspected, then it might flutter or flap around during conveying which causes false or faulty detection. In that case, you must take whatever methods needed such as clamping the workpiece on the production line to reduce flutter or flapping as much as possible. You may need to take other precautions depending on the workpiece or conveyor configuration, so please consult us for assistance.

Q What types of workpieces are impossible to inspect?

A Pinholes cannot be detected if contents are sealed inside, or workpiece has a bag shape or is completely transparent. Detection is also impossible if the faulty point on the workpiece is so tiny that it exceeds the detector's capabilities.
Also, though not totally impossible, the following items are difficult to inspect under certain conditions.
Material through which light passes: Printed materials, non-planar shaped materials, and highly transparent materials.
Material impervious to light; Complex-shaped materials, rubber materials
The result (pass/fail) is determined by making an evaluation of an actual sample workpiece.

Q Is it possible to raise the detection speed and detection performance?

A It is not possible to boost detection speed or detection capability higher than the product specifications of pinhole inspection units. However, detection performance is determined by evaluating an actual sample workpiece. If the workpiece is a good match with the pinhole inspection unit to be used, then detection performance might be higher than the value listed in the catalog.

Q What type of light source is used?

A An LED or laser diode is used as the light source, depending on the pinhole inspection unit. See the product description pages (pages 8 to 13) for detailed information on each product.

Q Can optical pinhole inspection units be used offline?

A Yes, some models can be used offline. Hamamatsu offers the following offline control units.
(Note: Not used for the C11740, C12760 and C12190 optical pinhole inspection units.)

Off-line control unit C12043 series

The C12043 series is an offline control unit for manual operation and making operating checks, etc.

There are two models available: the C12043-02 with digital panel meter and the C12043-01 with no digital panel meter.



Q Does the detection accuracy change with the workpiece conveyor speed?

A There is no change in accuracy if kept within the maximum detection speed.

Q If false or faulty detection occurs during inspection, what are some likely causes?

A False detection tends to occur when ambient light around the detector is not being blocked well enough. So most false detections can be prevented by installing light shielding around the measurement points. Our engineers can offer advice on light blocking measures based on the past records of problems and solutions. Also in rare cases, false detection occurs due to reasons other than light blocking problems. Feel free to consult us about any detection problems that occur after you receive the optical pinhole inspection unit.

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