

JIS

JAPANESE INDUSTRIAL STANDARD

Photoelectric switches

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**In the event of any doubt arising,
the original Standard in Japanese is to be final authority.**

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J I S

Photoelectric switches

C 4525-1992

1. Scope

This Japanese Industrial Standard specifies photoelectric switches for use in industrial control circuits at a voltage not exceeding a.c. 250 V (at a frequency 50 Hz or 60 Hz) or d.c. 60 V.

Remarks: The following Standards are cited in this Standard:

JIS C 0020-Basic Environmental Testing Procedures Part 2: Tests,
Tests A: Cold

JIS C 0021-Basic Environmental Testing Procedures Part 2: Tests,
Test B: Dry Heat

JIS C 0022-Basic Environmental Testing Procedures Part 2: Tests,
Test Ca: Damp Heat, Steady State

JIS C 0040-Basic Environmental Testing Procedures Part 2: Tests,
Test Fc and Guidance: Vibration (Sinusoidal)

JIS C 0041-Basic Environmental Testing Procedures Part 2: Tests,
Test Ea: Shock

JIS C 0704-Insulation Test for Control Gear

JIS C 1102-Electrical Indicating Instruments

JIS C 1302-Insulation Resistance Testers (Battery Operated)

JIS C 1609-Illuminance Meters

JIS P 3301-Drawing Papers

JIS Z 8801-Test Sieves

2. Definitions

For the purpose of this Standard the following principal definitions apply:

- (1) photoelectric switch A detecting switch of noncontact type which detects existence or non-existence, size, etc. of the object to be detected by measuring the increase or decrease of light quantity caused by the detection object on the light emitted from the projector with its light receiver employing photoelectric elements.
- (2) reflection system A system in which the quantity of light reaching the light receiver is detected when the light from the projector is reflected by the detection object.

- (3) transmission system A system in which the quantity of light reaching the light receiver is detected when the light from the projector is interrupted by the detection object.
- (4) reflector system A system in which the quantity of light reaching to the light receiver is detected when the light emitted from the projector and reflected by the reflex reflector is interrupted by the detection object.
- (5) light-on type An operating type in which the output switching element turns on due to increase of light quantity.
- (6) dark-on type An operating type in which the output switching element turns on due to decrease of light quantity.
- (7) contact output type An output type in which the contact of a relay is employed as the output switching element.
- (8) a.c. 2-wire system Such a contactless output system that single-phase a.c. power supply is used, thyristers or the like are employed as output switching element and the photoelectric switch and the load is connected in series.
- (9) d.c. 3-wire system Such a contactless output system that d.c. power supply is used, two power supply wires and one output wire are provided and the load is connected between the output wire and one of the power supply wire.
- (10) rated working voltage of output section The voltage used for control output section in correlation with the rated working current.
- (11) rated working current of output section The current used for control output section under specified conditions (rated working voltage, switching frequency and electrical endurance).
- (12) rated detection distance The distance between the detecting plane and the standard detection object at which detection by means of a photoelectric switch of reflection type shall be feasible under the specified conditions (standard service conditions and standard power supply).

The distance between the projector and the light receiver at which detection by means of a photoelectric switch of transmission system shall be feasible under the specified conditions (standard service conditions, standard power supply and standard detection object).

The distance between the detecting plane and the reflex reflector at which detection by means of a photoelectric switch of reflector system shall be feasible under the specified conditions (standard service conditions, standard power supply and standard detection object).
- (13) standard detection object A detection object to serve as a standard for measurements of basic performances and characteristics of switch and its shape, dimensions and materials are specified.
- (14) detection object An object to be detected by a photoelectric switch.

- (15) leakage current The current which flows through the output terminations of an output switching element under the off state.
- (16) residual voltage The value of voltage drop which appears across the output terminations of an output switching element under on-state.
- (17) switching frequency The number of repetition of output per second at which the prescribed output can be obtained when output switching is done by the detection object.
- (18) ambient illuminance (in service) The brightness at the location of switch at which the switch can operate under specified conditions (standard service conditions, standard power supply and standard detection object). It is expressed by the illuminance at the light receiving plane.
- (19) projector of photoelectric switch A part of switch which accommodates such a light source as an incandescent lamp and light emitting diode, has functions to radiate a prescribed light and includes an optical system consisting of lens, etc.
- (20) light receiver of photoelectric switch A part of switch which detects the light emitted from the projector and includes an optical system consisting of photoelectric elements and lenses.

3. Standard service conditions and standard power supply

3.1 Standard service conditions The standard service conditions shall be as given below. However, neither freezing nor sweating shall occur under the conditions.

- (1) Ambient temperature: -10 to +55°C
- (2) Relative humidity: 45 to 85 %
- (3) Altitude: 2000 m or less

3.2 Standard power supply An a.c. power supply of substantially sinusoidal waveform or a d.c. power supply of less ripple as possible (e.g. three-phase full-wave rectified power source) shall be used as the standard power supply, unless any trouble appears on the characteristics of other apparatus during service.

4. Classification

4.1 Classification by detecting system Switches are classified according to the detecting system as follows:

- (1) Reflection system
- (2) Transmission system
- (3) Reflector system

4.2 Classification by style of operation The switches are classified according to the style of operation as follows:

- (1) Light-on type
- (2) Dark-on type

4.3 Classification by style of output The switches are classified according to the style of output as follows:

- (1) Contact output system
- (2) A.C. 2-wire system
- (3) D.C. 3-wire system

4.4 Classification by protection system The switches are classified according to the protection system as given in Table 1.

Table 1. Classification by protection system

		Second symbol Degree of protection against ingress of water						
		0 (Open type)	2 Drip-proof (II type)	3 (Rain-proof type)	4 (Splash-proof type)	5 (Jet-proof type)	6 (Water-proof type)	7 (Immersion-proof type)
First symbol Degree of protection against solid foreign matter	3 (Semi enclosed type)	△	○	○	△			
	4 (Totally enclosed type)	△	○	○	○			
	5 (Dust-protected type)	△	○	○	○	○		
	6 (Dust-tight type)	△			○	○	○	○

- Remarks 1. The designation by symbol shall be arranged in the order of the letters denoting protection system (IP), first symbol and second symbol.
2. When either the first symbol or second symbol is not specified, such fact shall be denoted by symbol X.
Example: 1P 6 X
3. The mark ○ in this table indicates standard combination, and △ indicates quasi-standard combination.

5. Ratings

5.1 Rated frequency When a.c. rated voltages are employed the rated frequency shall be as given in Table 2.

Table 2. Rated frequency

Unit: Hz		
Rated frequency		
50	60	50/60

5.2 Rated insulation voltage The rated insulation voltage shall be as given in Table 3.

Table 3. Rated insulation voltage

Unit: V		
Kind of power	Rated insulation voltage	
A.C.	125	250
D.C.	30	60

5.3 Rated working voltage of control section The rated working voltage of the control section shall be as given in Table 4.

Table 4. Rated working voltage of control section

Unit: V		
Kind of power	Rated working voltage	
A.C.	100	200
D.C.	12	24

5.4 Ratings of contact output section

(1) Rated working voltage of contact output section The rated working voltage of contact output section shall be as given in Table 5.

Table 5. Rated working voltage of contact output section

Unit: V		
Kind of power	Rated working voltage of contact output section	
A.C.	100	200
D.C.	24	48

- (2) Rated working current of contact output section The rated working current of contact output section shall be as given in Table 6.

Table 6. Rated working current of contact output section

Unit: A

Rated working current of contact output section				
0.5	1	2	3	5

5.5 Ratings of contactless output section

- (1) Rated working voltage of contactless output section The rated working voltage of contactless output section shall be as given in Table 7.

Table 7. Rated working voltage of contactless output section

Unit: V

Kind of power	Rated working voltage of contactless output section	
A.C.	100	200
D.C.	12	24

- (2) Rated working current of contactless output section The rated working current of contactless output section shall be as given in Table 8.

Table 8. Rated working current of contactless output section

Unit: mA

Rated working current of contactless output section			
50	80	100	200

- 5.6 Rated detection distance The rated detection distance shall be as given in Table 9.

Table 9. Rated detection distance

Unit	Rated detection distance									
mm	5	10	20	30	50	100	200	300	500	700
m	1	1.5	2	3	5	10				

6. Performances

- 6.1 Operation When the specimen is tested for its operation in accordance with 8.2.2, the conditions of the output section shall be good.

6.2 Ambient illuminance One of the values given in Table 10 shall be specified as the ambient illuminance, and the specimen shall satisfy the requirements of 6.1 at the specified illuminance when subjected to the test of 8.2.3.

Table 10. Ambient illuminance

Unit: lx

Ambient illuminance (illuminance at light receiving plane)								
100	200	300	500	1000	2000	3000	5000	10000

6.3 Switching frequency One of the values given in Table 11 shall be specified as the switching frequency, and the specimen shall show a switching frequency not less than the specified value when subjected to the test of 8.2.4.

Table 11. Switching frequency

Unit: Cycle/s

Kind of output	Switching frequency					
Contact output						
A. C. 2-wire system	1	2	5	10		
D.C. 3-wire system	50	100	200	300	500	1000

6.4 Change in voltage and temperature When the specimen is tested for change in voltage and temperature as specified in 8.2.5, the conditions of its output section shall be good.

6.5 Temperature rise The temperature rise shall not exceed the specified value in Table 12 when the specimen is tested in accordance with 8.2.6.

Table 12. Temperature rise

Unit: °C

Position	Temperature rise value
Terminal part to which external insulated wire is connected	50
Metal part in contact with insulating material	A temperature which does not damage the insulating material. For example, the temperature rise of metal parts in contact with phenolic resin moulding shall be 100°C.

6.6 Switching of output section

- (1) Resistance of contact output section The resistance between terminals shall not exceed 500 mΩ when the resistance of contact output section is examined as specified in 8.2.7 (1). This resistance includes the resistance of lead wire in addition to the contact resistance.

- (2) Switching of contactless output section When the switching of contactless output section is examined as specified in 8.2.7 (2), the residual voltage shall not exceed that specified in Table 13 at on-state of the output section, and the leakage current shall not exceed that specified in Table 14 at off-state of the output section.

Table 13. Residual voltage

Unit: V

Classification	Residual voltage	
A.C. 2-wire system	10	
D.C. 3-wire system	1.2	2.4

Table 14. Leakage current

Unit: mA

Classification	Leakage current	
A.C. 2-wire system	2	5
D.C. 3-wire system	0.5	

6.7 Insulation resistance The insulation resistance shall be not less than 20 M Ω when measured in accordance with 8.2.8.

6.8 Dielectric withstand voltage When the dielectric withstanding voltage test is carried out as specified in 8.2.9, the specimen shall withstand the test voltage.

6.9 Resistance to vibration The resistance to vibration shall comply with the following requirements:

- (1) Endurance to vibration When the endurance to vibration is examined in accordance with 8.2.10 (1), the specimen shall show no damage on its outside and shall satisfy the provision of 6.1.
- (2) Malfunction due to vibration When the malfunction due to vibration is examined in accordance with 8.2.10 (2), the duration of separation or reversal of the output section shall be as given in Table 15.

Table 15. Duration of separation and reversal

Output style	Duration of separation	Duration of reversal
Contact output system	1 ms max.	—
A.C. 2-wire system	—	1 ms max.
D.C. 3-wire system	—	50 μ s max.