

JIS

JAPANESE INDUSTRIAL STANDARD

**Multilayer printed
wiring boards**

JIS C 5014—1994

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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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Multilayer printed wiring boards

C 5014-1994

1. Scope This Japanese Industrial Standard specifies multilayer printed wiring boards mainly used for electronic apparatus (hereafter referred to as "printed boards"). However, this Standard is not applicable to multilayer flexible printed wiring board, multilayer rigid to flexible printed wiring board and metal-cored printed wiring board.

Remarks: 1. The following Standards are cited in this Standard:

JIS C 5001 General rules for electronic components

JIS C 5012 Test methods for printed wiring boards

JIS C 5603 Terms and definitions for printed circuits

JIS C 6480 General rules of copper-clad laminates for printed wiring boards

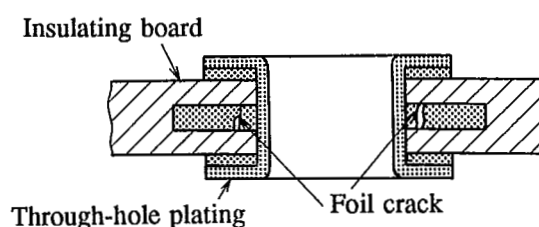
2. The International standards corresponding to this Standard are given below:

IEC 326-3 (1991) Printed boards. Part 3: Design and use of printed boards

IEC 326-6 (1980) Printed boards. Part 6: Specification for multilayer printed boards

2. Definitions For the purpose of this Standard in addition to the definitions in JIS C 5001 and JIS C 5603, the following principal definitions apply:

- (1) insertion mounting Such a mounting method that terminals of a component are inserted into component holes provided on a printed board and electrically connected.
- (2) foil crack The crack of copper foil connected with a plated-through hole that appears in the vicinity of the through-hole plating.



- (3) reference mark The mark attached to a corner of printed board for determination of correct position of the board.
- (4) component positioning mark The mark which is provided for determination of component position relative to the reference mark on a printed board.

3. Grade The grades which express the precision and quality of patterns on printed board dealt with in this Standard are given below.

These grades are used in such a way that a necessary grade is selected on each item to be specified.

The provisions in which no classification by grade is specified shall apply to all the classes.

Class I A class for which normal level is required.

Class II A class for which a high level is required.

Class III A class for which a specially high level is required.

4. Design standard and tolerance thereon

4.1 Grid dimensions

4.1.1 Basic grid As for grids of printed boards, the grid of metric system shall be used as the standard, and the grid of inch system shall be used only when compatibility with the traditional product is necessary.

For basic grid dimensions, the following dimensions shall be used:

Basic grid dimension of metric system: 2.50 mm

Basic grid dimension of inch system: 2.54 mm

4.1.2 Auxiliary grid If grid dimension smaller than that of basic grid of 4.1.1 is necessary, the following dimensions shall be used.

Grid of metric system: unit of 0.5 mm (if further smaller unit is necessary, unit of 0.05 mm shall be employed)

Grid of inch system: unit of 0.635 mm

4.2 Reference line A reference line composed of at least two holes or a pattern shall be provided.

The reference line shall lie on the grid and should preferably lie inside of the visible outline.

4.3 External dimensions

4.3.1 External dimensions It is preferable that the dimension of each side in the outline of printed board employing the copper clad laminate specified in JIS C 6480 should have the external dimension by which the board can be efficiently arranged in the panel dimensions given in Table 1.

Table 1. Panel dimensions

Unit: mm

Dimensions of laminate	Number of divisions			
	4	6	8	9
1000 × 1000	500 × 500	333 × 500	250 × 500	333 × 333
1000 × 1200	500 × 600	333 × 600 500 × 400	500 × 300	333 × 400

4.3.2 Tolerances on external dimensions The tolerances on external dimensions shall be as specified in Table 2.

Table 2 is also applicable to the dimensions of square holes machined at the same time with the outline machining.

Table 2. Tolerances on external dimensions

Unit: mm

External dimension	Class		
	I	II	III
Up to and including 100	±0.4	±0.2	±0.1
Over 100	For a dimension exceeding 100, 0.2 shall be added per a dimensional increase up to 50.	For a dimension exceeding 100, 0.1 shall be added per a dimensional increase up to 50	For a dimension exceeding 100, 0.05 shall be added per a dimensional increase up to 50.

4.4 Total board thickness

4.4.1 Total board thickness and tolerance The total board thickness (*t*) including the plating, solder resist and symbol mark shown in Fig. 1 and the tolerances thereon shall be as given in Table 3.

Fig. 1. Total board thickness

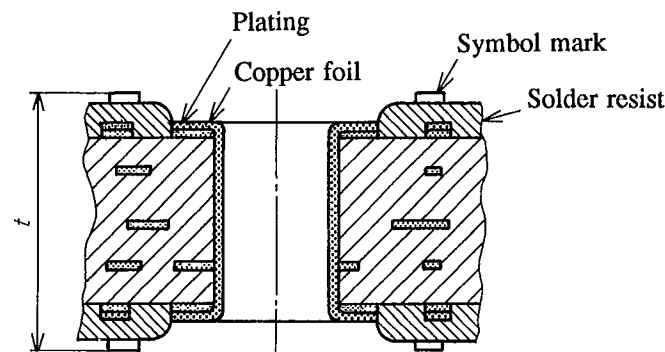


Table 3. Total board thickness and tolerance

Unit: mm

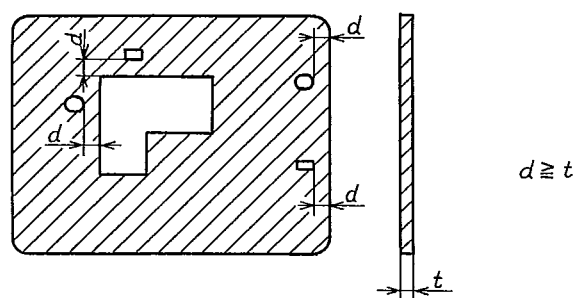
Total board thickness t	Class		
	I	II	III
0.4 ⁽¹⁾	—	—	+0.1 -0.05
0.6 ⁽¹⁾			±0.1
0.8	±0.2	±0.15	
1.0			±0.12
1.2	±0.23	±0.17	±0.13
1.6	±0.25	±0.19	±0.15
2.0 or more	±13 %	±10 %	±8 %

Note ⁽¹⁾ The nominal values are subjected to agreement between the parties concerned with delivery.

4.5 Hole

4.5.1 Distance between hole and board edge The minimum distance (d) between the inner wall of a hole and the edge of board as illustrated in Fig. 2, shall be not less than the board thickness (t) of the printed board.

Fig. 2. Distance between hole and board edge



4.5.2 Position of hole It is preferable that the center of a hole lies at the intersection of grid lines (including auxiliary grid). The allowable deviation ($|\vec{a}|$) of a hole from its position specified in the design by means of coordinates employing the reference hole as the original point shown in Fig. 3 shall be as given in Table 4. However, via holes are out of subject.

Fig. 3. Position of component hole

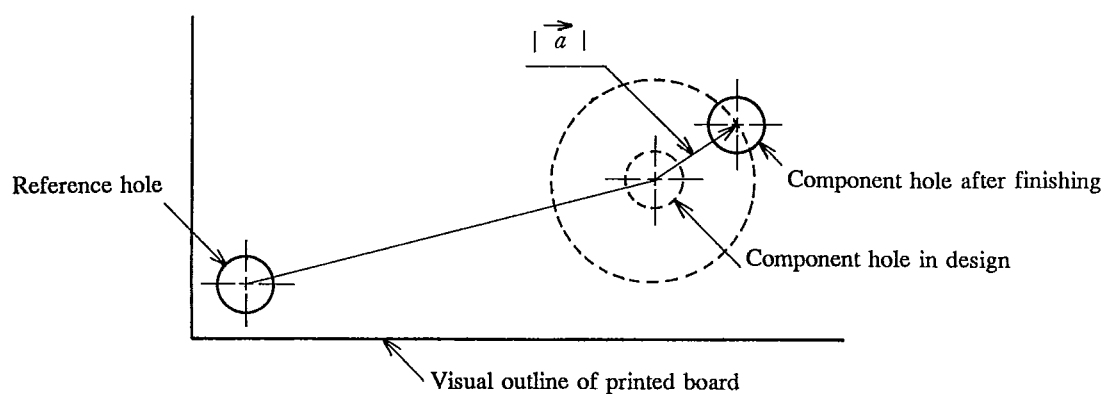


Table 4. Tolerances on position of component hole based on reference hole

Unit: mm

Longitudinal dimension of printed board (l)	Class		
	I	II	III
$l \leq 400$	0.25	0.15	0.10
400 1	For a dimension exceeding 400, 0.05 shall be added per a dimensional increase up to 100.		

4.5.3 Tolerance on diameter of component hole The tolerances on diameters of component holes shall be as given in Table 5. However, these tolerances are not applicable to via holes.

Table 5. Tolerance on diameter of component hole

Unit: mm

Item		Class		
		I	II	III
With through-hole plating	0.6 or over to and excl. 2.0	± 0.15	± 0.10	± 0.08
	2.0 or over	± 0.20	± 0.15	± 0.10
Without through-hole plating		± 0.15	± 0.10	± 0.05

4.5.4 Reference holes

- (1) Tolerance on position of reference holes The tolerance on position (b) of reference holes without through-hole plating as illustrated in Fig. 4 shall be as given in Table 6.

Fig. 4. Tolerance on position of reference holes

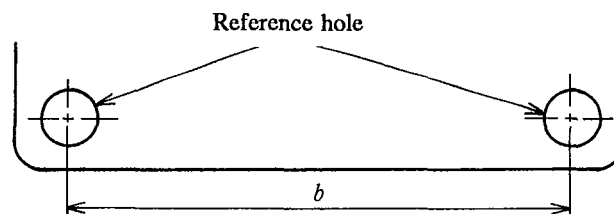


Table 6. Tolerance on position of reference holes

Unit: mm

Distance between hole centers (d)	Class		
	I	II	III
$d < 150$	± 0.10	± 0.08	± 0.05
$150 \leq d < 300$	± 0.15	± 0.10	± 0.08
$300 \leq d$	± 0.20	± 0.15	± 0.10

- (2) Tolerance on diameter of reference hole The tolerances on diameters of reference holes without through-hole plating shall be as given in Table 7.

Table 7. Tolerance on diameter of reference hole

Unit: mm

Item	Class		
	I	II	III
Tolerance	± 0.08	± 0.05	± 0.04

4.6 Conductor

4.6.1 Designed conductor width The designed conductor width shall be as given in Table 8.

Table 8. Designed conductor width

Unit: mm

Item	Class		
	I	II	III
Designed conductor width (w) ⁽²⁾	$0.18 \leq w$	$0.13 \leq w < 0.18$	$0.1 \leq w < 0.13$

Note ⁽²⁾ The classification is made by taking the minimum conductor width in the design drawing as the subject.

4.6.2 Tolerance on finished conductor width The tolerance on finished conductor width (w) shown in Fig. 5 shall be as given in Table 9.

Fig. 5. Conductor width and spacing between conductors after finish

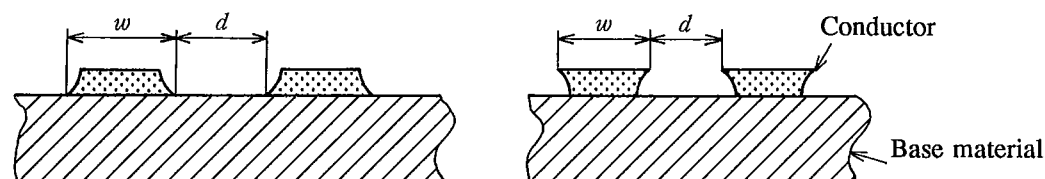


Table 9. Tolerance on finished conductor width

Unit: mm

Item	Class		
	I	II	III
Tolerance ⁽³⁾	± 0.07	± 0.05	± 0.04

Note ⁽³⁾ When the designed conductor width exceeds 0.3 mm, the tolerance on finished width shall be ± 0.1 mm.

4.7 Spacing

4.7.1 Designed spacing between conductors The designed spacing between conductors shall be as given in Table 10.

Table 10. Designed spacing between conductors

Unit: mm

Item	Class		
	I	II	III
Designed spacing between conductors (s) (⁴)	$0.22 \leq s$	$0.17 \leq s < 0.22$	$0.13 \leq s < 0.17$

Note (⁴) The classification is made by taking the minimum spacing between conductors in the design drawing as the subject.

4.7.2 Tolerance on finished spacing between conductors The tolerance on finished spacing between conductors (d) shown in Fig. 5 shall be as given in Table 11.

Table 11. Tolerance on finished spacing between conductors

Unit: mm

Item	Class		
	I	II	III
Tolerance (⁵)	± 0.07	± 0.05	± 0.04

Note (⁵) When the designed spacing between conductors exceeds 0.3 mm, the tolerance after finishing shall be ± 0.1 mm.

4.7.3 Spacing between through-hole wall and conductor The minimum designed spacing between conductors necessary to ensure the spacing between through-hole wall and internal-layer conductor specified in 5.1 shall be as shown in Table 12.

Table 12. Minimum designed spacing between conductors

Unit: mm

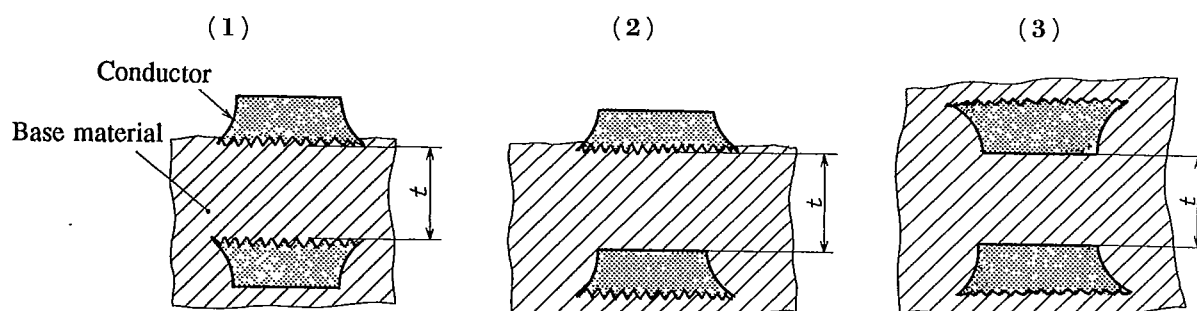
Item	Class		
	I	II	III
Minimum designed spacing between conductors (⁶)	0.5	0.45	0.4

Note (⁶) In some cases different values are necessary according to the voltage across conductors employed.

4.7.4 Minimum thickness of insulation layer The minimum thickness of insulation layer in the design shall be 0.10 mm, and the minimum thickness (t) of each finished insulation layer as illustrated in Fig. 6 shall be 0.08 mm.

When the minimum thickness of insulation layer in the design is less than 0.1 mm, the actual thickness is subjected to agreement between the parties concerned with delivery.

Fig. 6. Thickness of insulation layer



Remarks: This thickness is applicable to the part where the thickness of insulation layer becomes the minimum due to roughness of conductor as illustrated in Fig. 6 (1) and (2).

4.7.5 Distance between conductor and board edge The distance between conductor and board edge shall be at least 1.25 mm in the external layer, 1.25 mm in the internal layer and 0.30 mm at the ground plane. However, printed contacts are excluded.

4.8 Size and shape of land

4.8.1 Internal-layer land

- (1) The size and shape of internal-layer land shall be designed by taking the following item (2) and the minimum width of land (Table 23) given in 5.3 into consideration.
- (2) The permissible discrepancy between centers of internal-layer land and of through hole shall be as given in Table 13.

Table 13. Permissible discrepancy between centers of internal-layer land and of through hole

Unit: mm

Item	Class		
	I	II	III
Permissible discrepancy	±0.3	±0.25	±0.2

4.8.2 External-layer land

- (1) The size and shape of external-layer land shall be designed by taking the following item (2) and the minimum land width (Table 23) given in 5.3 into consideration.
- (2) The permissible discrepancy between centers of external-layer land and of through hole shall be as given in Table 14.

Table 14. Permissible discrepancy between centers of external-layer land and of through hole

Unit: mm

Item	Class		
	I	II	III
Permissible discrepancy	± 0.3	± 0.25	± 0.15

4.9 Printed contacts

4.9.1 Tolerance on distance between centers of printed contacts The tolerance on distance between centers of printed contacts shall be as given in Table 15. When the distance between centers of conductors on printed contacts exceeds 100 mm, 0.01 mm shall be added for each of excess 20 mm.

Table 15. Tolerance on distance between centers of printed contacts

Unit: mm

Item	Class		
	I	II	III
Tolerance	± 0.20	± 0.10	± 0.05

4.9.2 Terminal width of printed contacts In the case of specifying the tolerance on terminal width (w) of printed contacts as illustrated in Fig. 7, Table 16 shall be followed.

Fig. 7. Terminal width of printed contacts

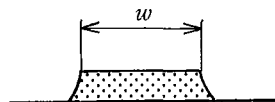


Table 16. Tolerance on terminal width of pointed contacts

Unit: mm

Terminal width (w)	Tolerance
$w \leq 1.0$	± 0.05
$1.0 < w$	± 0.1

4.9.3 Misalignment of centers of front and rear printed contacts The misalignment of centers of front and rear printed contacts (c) as illustrated in Fig. 8, shall be as given in Table 17.

Fig. 8. Misalignment of centers of front and rear printed contacts

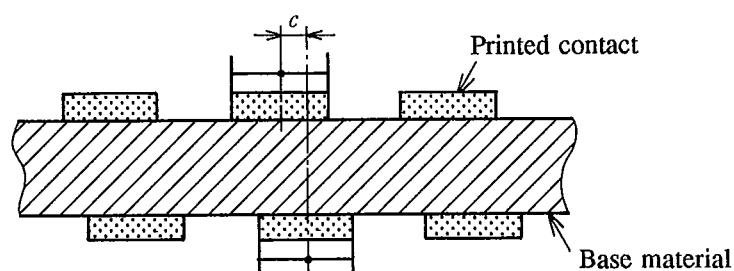


Table 17. Permissible discrepancy between centers of front and rear printed contacts

Unit: mm

Item	Class		
	I	II	III
Permissible misalignment	0.30	0.20	0.10

4.10 Tolerance on footprint

4.10.1 Tolerance on distance between pad centers In the footprint shown in Fig. 9, the tolerances on the distance between adjacent pad centers (e_1) and that on the distance between centers of pads located in parallel at both ends (e), shall be as given in Table 18.