

Bonding Technology of FPD(Flat Panel Display)

OSAKI ENGINEERING CO., LTD.(OEC) has been playing the pioneering role in bonding technology development of FPD, and obtained reliance as a leading maker. This technical data explains the bonding technology of FPD including the most useful know-how on the spot.

LCD (Liquid Crystal Display) which is the representation of FPD could not do solder junction that is generally used in the world, because it has used ITO (Indium Tin Oxide) electrode formed on the glass substrate since it was the early simple matrix (passive matrix).

So, a zebra, heat sealing, etc. are used for circuits' design of LCD of a segment display, such as a calculator and a clock.

Now, LCD of a dot-matrix display widely used for a PC or LCD television have been used ACF (Anisotropic Conductive Film) junction because there are many terminals, the terminal pitch is fine and high precision junction is required. ACF whose connection resistance is low and which excels in heat resistance and connection reliability is used for other FPDs(Flat Panel Display), such as PDP(Plasma Display Panel) and OLED(Organic LED).

Zebra rubber: It is the thing that laminates the conductive rubber which added carbon and others as an electric conduction object and insulated rubber mutually.

Heat sealing: It is the thing that carries out printing formation of the circuit with thermoplastic conductive adhesives at a film base material.

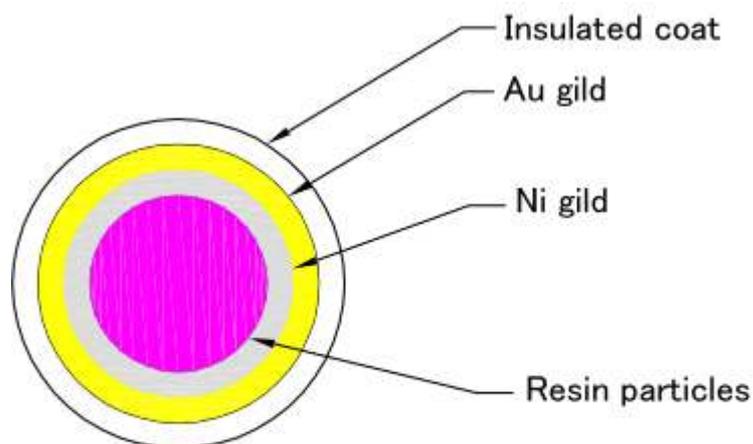
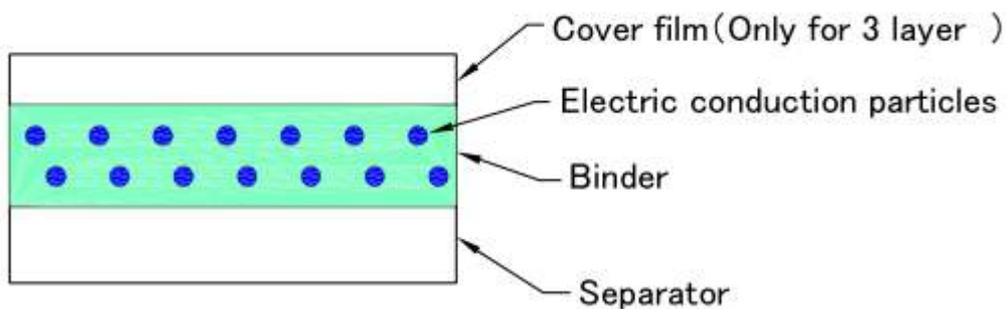
Junction method \ Pitch	Pitch				
	50	100	200	300	400 μ m
Zebra rubber					█
Heat sealing				█	█
ACF	█	█	█	█	

What's ACF(Anisotropic Conductive Film)?

ACF is the matter that applied the adhesives of 10 to 50 micrometer thickness which disperses the electric conduction particle uniformly on the support film (separator) of PET (Polyethylene Terephthalate) etc., and is wound around the reel by the shape of a tape with a width of 1 to 3mm and a length 50 to 200 meter.

The true ball-like resin with Ni-Au gild is used for the connection with a glass substrate, and with Ni particles is used for PWB (Printed Wiring Board).

By arranging between the circuits which counter and applying heat and force, it is the connection material which can perform electric junction and mechanical adhesion for many electrodes below a 100-micrometer pitch.



Example of a electric conduction particle

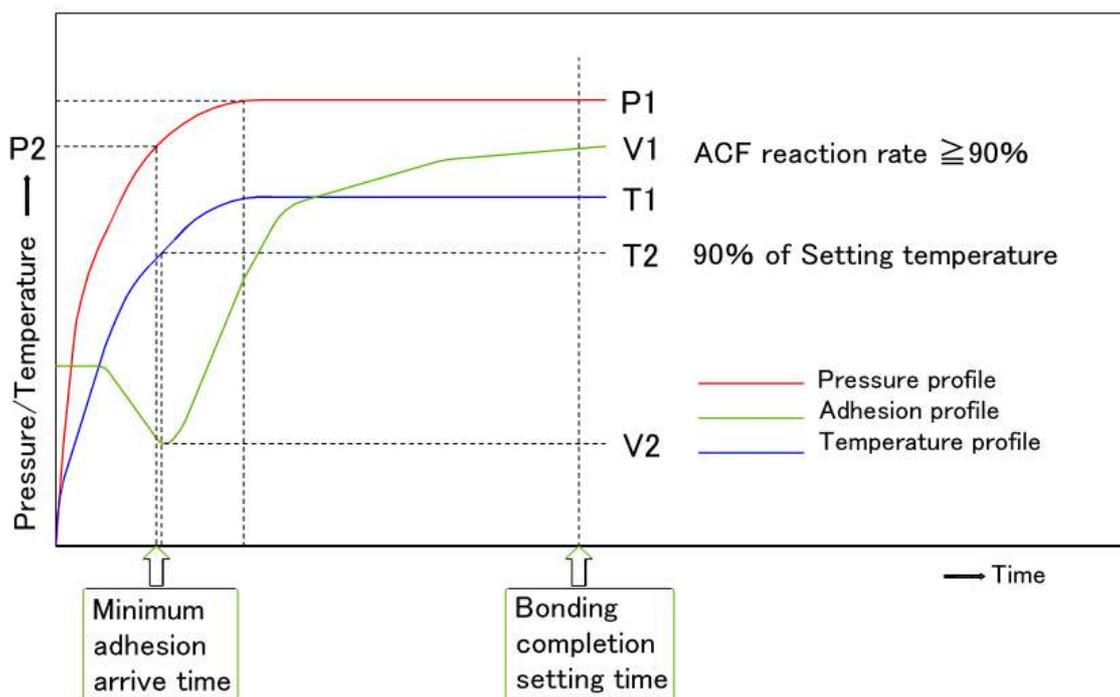
Bonding mechanism

If around 180 to 210 degree heat is applied to a bonding head, the adhesion of ACF falls rapidly. As the mobilized resin flows out of the crevice between up-and-down electrodes, it satisfies the up-and-down electrode circumference, and it is hardens rapidly.

Moreover, electric conduction particles are confined between up-and-down electrodes by the pressure applied simultaneously.

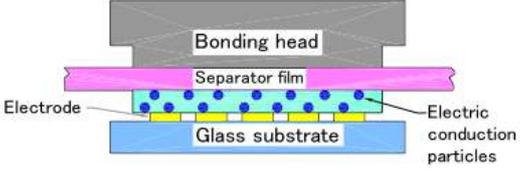
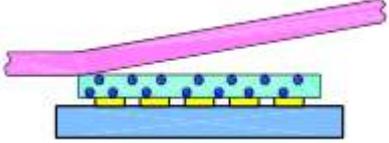
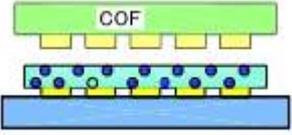
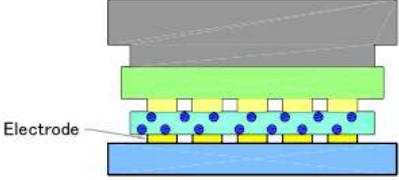
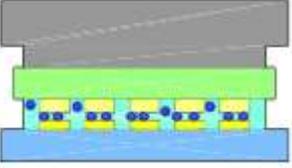
This metal skin film of the electric conduction particle surface enables the electrical connection between up and down electrodes (anisotropy conductive connection), and make it possible to connect.

Fine control of heat and pressure is important for this process, and it is greatly influenced by the rigid conditions of the equipment supporting the kind of ACF to be used, a panel electrode, and a bonding tool etc.



The example of a profile of pressure and a temperature setup in an ACF method.

The connection process of ACF

ACF attach		<p>Temperature: 60 to 90 °C</p> <p>Pressure: 0.5 to 1.5 MPa</p> <p>Time: 1 to 2 seconds</p>
Separator film peel off		
Alignment		
Pre-bonding		<p>Temperature: 60 to 100 °C</p> <p>Pressure: 0.5 to 1.5 MPa</p> <p>Time: 0.1 to 1 seconds</p>
Main bonding		<p>Temperature: 180 to 200 °C</p> <p>Pressure: 2 to 4 MPa</p> <p>Time: 10 to 20 seconds</p>

TAB (Tape Automated Bonding) and COF (Chip On Film)

There are TAB, COF, etc. in the driver circuit joined to the terminal on the glass substrate of LCD by ACF.

TAB has been widely used as a package of a LCD driver. However, conversion to COF is progressing quickly by progress of enlargement of the display of a cellular phone, and colorization.

Compared with TAB, COF bonding enables detailed correspondence of a bonding pitch and free arrangement of it.

Osaki Engineering Co., Ltd. (OEC) offers reliable FOG boder that can solve the characteristic problems of COF such as badness of the mark recognition caused by the thinness of COF.

	TAB	COF
Fine pitch	△	○ Anywhere OK.
Bending flexibility	△	○
Tape cost	△	○
Design flexibility	△	○
Thinness	△	○

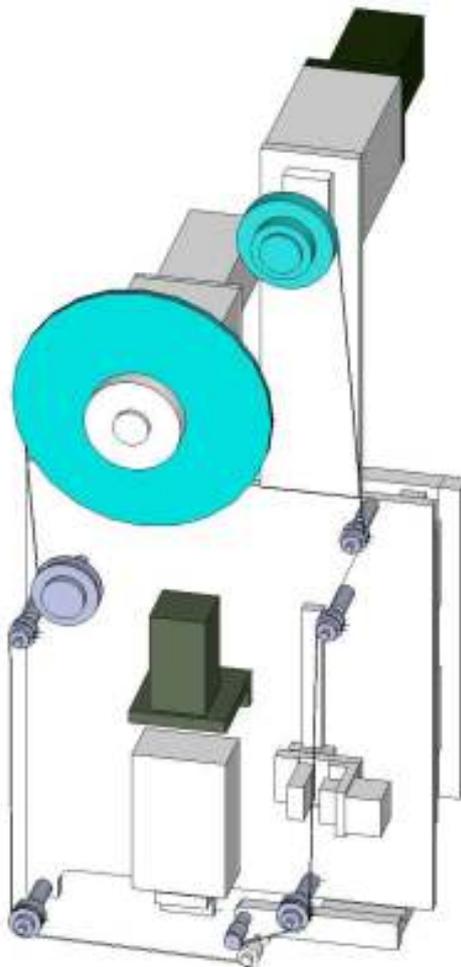
ACF lamination

ACF cut at a designated length is laminated onto the electrode of LCD or TAB/COF, and then the separator film is peeled off.

Although the advanced know-how is required for the method of ACF lamination for TAB/COF, it can reduce the loss at the time of supply of ACF material, and it is proved that the working ratio and productivity of the whole bonding line go up by leaps and bounds.

Prior cleaning of the portion which laminates ACF is carried out in the OEC machine.

Moreover, OEC can provide the inspection after ACF lamination that keeps the product excellent.



Example of ACF lamination unit

Pre-bonding

Each alignment mark on the TAB/COF and LCD is aligned by vision system and the TAB/COF is pre-bonded onto the electrode of LCD.

There are two supply method of TAB/COF.

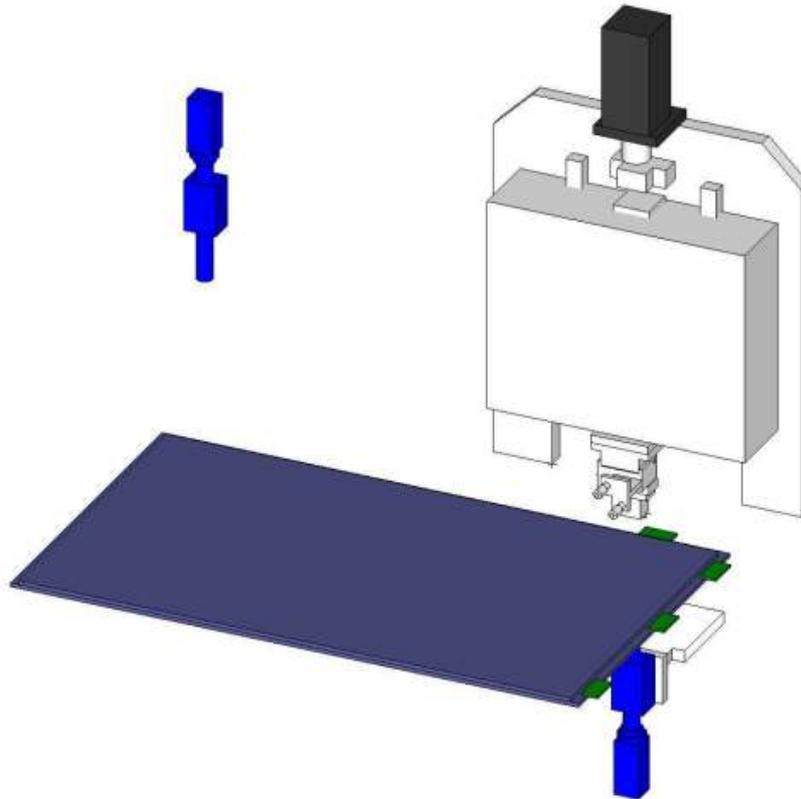
1. In-line system that die-punched COF/TAB is pre-bonded directly.
2. The tray loader system that TAB/COF is taken out from the tray and is pre-bonded.

Generally, it is normal to adopt the tray loader system since it is necessary for die-punching to maintain cleaning periodical.

The most important technical point of pre-bonding is in alignment accuracy.

Moreover, at an actual production plant, a camera may cause a recognition error by the dirt of the work itself.

OEC's unique Oic (OEC Imaging Controller) and high rigidity mechanism realize highly accuracy alignment and high recognition.



Example of pre-bonding unit

Main bonding heads

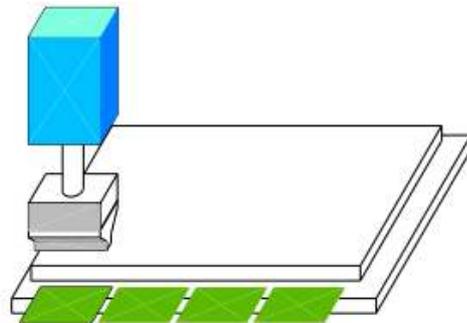
There are three ways for main bonding head as followings, and the system is determined by required accuracy, tact time and cost.

A multi-head system is generally adopted when you need high accuracy bonding for FPD.

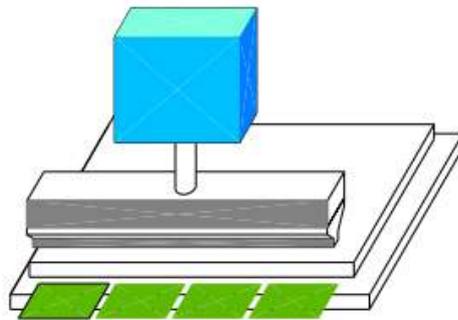
The most important technical point for main bonding process is the flatness of the head tip in high temperature and high pressure.

Our original fine adjustable mechanism and processing method keeps the flatness of head tip.

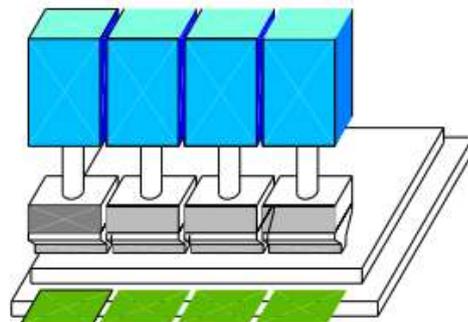
(1) Single head method



(2) Long bar method

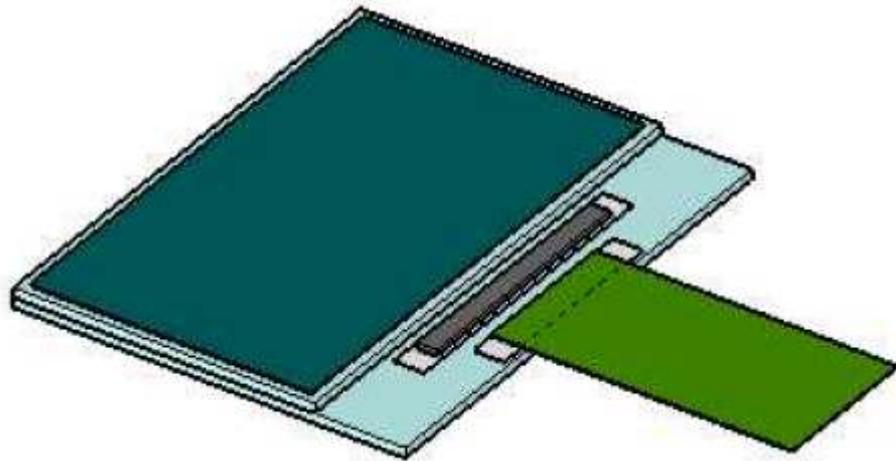
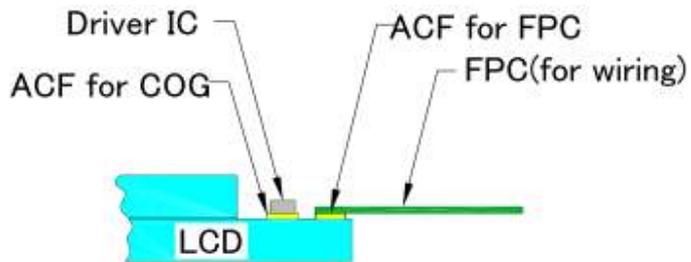


(3) Multi short bar method

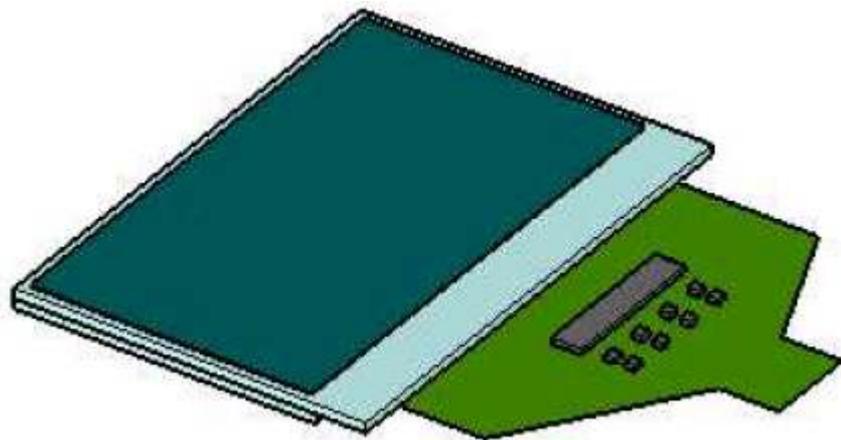
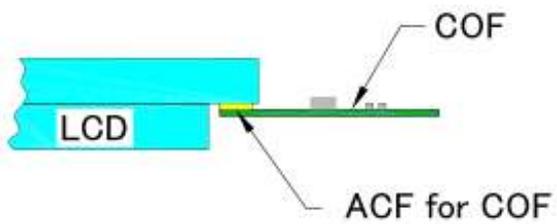


The example of small LCD bonding

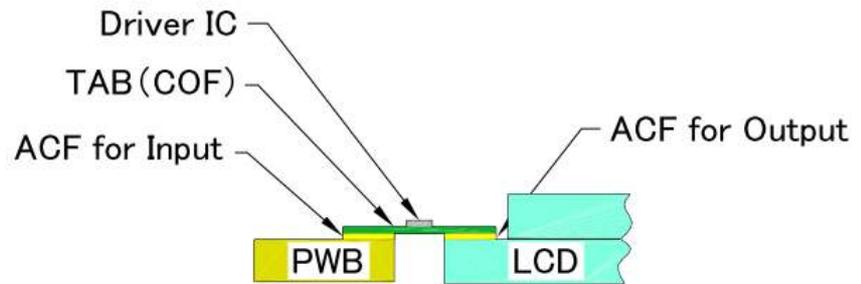
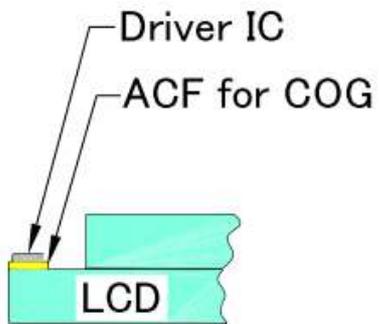
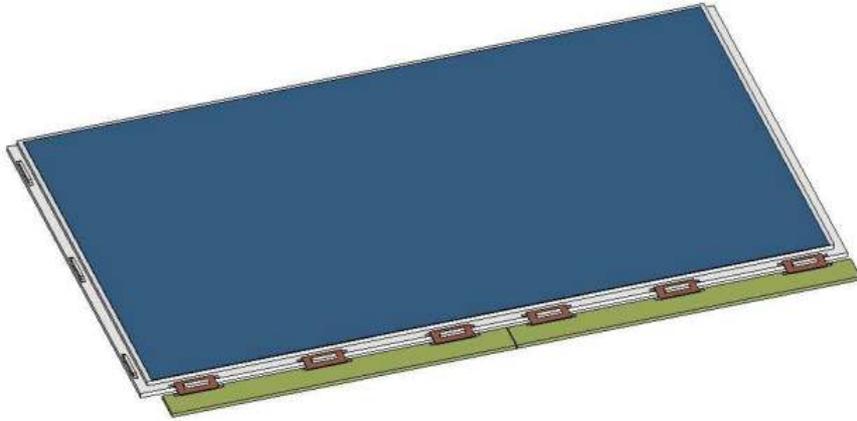
(1) COG (Chip on Glass)



(2) COF (Chip on Film)



The example of PC/TV LCD bonding



TAB tape size table

There is a standard size in a TAB tape and punching that there is no loss as possible is a point makes into low cost.

	A	B	C	D	E	F
	Tape width	Pitch	Hole width	Hole length	Edge measure	Hole space
35mm wide	34.975	4.75	1.981	1.981	2.01	29.996
35mm super	34.975	4.75	1.42	1.42	0.86	30.40
48mm wide	48.175	4.75	1.981	1.981	2.007	40.199
48mm super	48.175	4.75	1.42	1.42	0.9457	43.44
70mm wide	69.95	4.75	1.981	1.981	2.01	61.97

