"Laser Soldering": Pinpoint heating is perfect for ultrafine parts or high density mounting.

Laser soldering is now gaining attention as a new soldering method. However, as this is a new industrial technic compared to iron tip soldering, the heating principles differ, and it cannot simply replace iron soldering. Without understanding and properly utilizing the technical characteristics of both laser and iron soldering, soldering stability and quality are unattainable. This report will explain the principles of laser soldering, as well as cautious points for its utilization.

【The mechanism of laser heating process, “surface heating” differs from iron heating process of "heat transfer"】

There are three basic steps in soldering heating process, the first to "preheat" the soldering points, the second to "heat" in order to feed the solder, and the third to "post-heat" to set the shape. Both iron and laser soldering flow in this way, but the heat conversion theory of the two methods are different. Understanding differences is necessary in order to select the most appropriate methods for required soldering outcomes.

Iron soldering heating process is carried out as below steps.

1. Heating iron tip up to the set temperature.
2. Applying the tip to soldering point to heat up fusion temperature around the points
3. Feeding solder wire

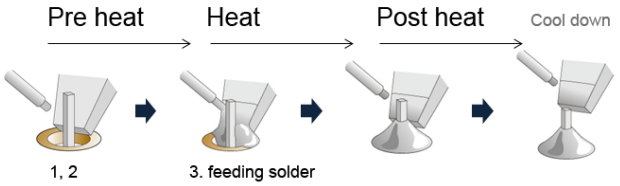

Fig.1 Iron soldering heating process

On the other hand, laser soldering heating process works in the following way.

1. Applying laser shot to soldering point
2. A land point developing heat
3. The pad surface heats up to fusion temperature
4. Feed the solder

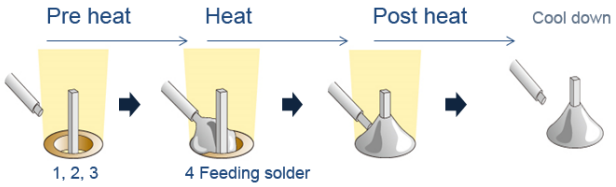

Fig. 2 Laser Soldering Heating Process

In iron soldering method, its heat is transferred through iron tips (heat transfer), while laser soldering produces heat on the applied points (surface heating).

Based on these methods, iron soldering does not heat over set temperature in most cases, however, if continued to apply the iron on land, the surrounding will heat up. In contrast, laser soldering heats the applied area locally. Furthermore, differing from iron

soldering, the absorbed energy instantaneously raises its heat level. Thus, when operating laser soldering, carelessness will quickly lead to overheating. As a result, to carry out proper laser soldering, firm expertise and experience in both soldering and laser technology are required.

	Laser	Iron
Thermal Conversion	Surface Heating	Heat Transfer
Heating Area	Limited	Diffusive
Heating Time	Instantaneous	Slow
Temperature	Continuous to rise	**Not** continuous to rise

Table 1：Differences in heating principles of laser and iron soldering

【Strength / reliability diminishes if temperature is too high or too low】

As the composition of solder changes based on heating conditions, neither sufficient strength nor reliability can be realized without soldering at the proper temperature.

For example, the internal composition of solder is mostly unchanged when soldered at the proper temperature. However, when soldering is overheated, the strength and reliability are diminished as the result of composition changes.

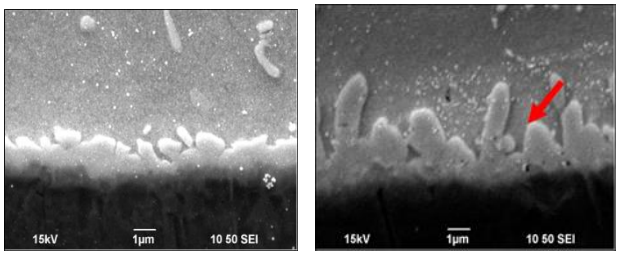

Fig3. Comparison of composition changes based on soldering

*The left figure, properly heated, displays a proper amount of intermetallic compounds, while the right figure, overheated, displays hypertrophy of intermetallic compounds.

In addition, the liquidity of flux changes based on temperature. For instance, when properly heated, the flux first flows into the soldered points and through-holes, removing dirt and oxides in the area and improving the soldering compatibility. In contrast, when overheated, solder moves into through-holes and stopping flux flow. Furthermore, overheating easily damages circuit boards, leaving cracks on the inside.

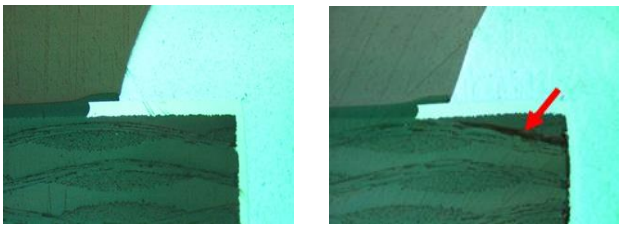

Fig 4 Comparison of effects of soldering temperature inside the substrate

*The left figure, heated properly, shows no circuit board damage, while the right figure, overheated, shows the appearance of cracks (arrow) on the inside of the substrate.

There are replacement requests from iron soldering to laser soldering today, simply because of its technological benefits as well as little maintenance. However without understanding the laser's distinct characteristics for soldering application, the advantage of the laser can be lost.

【The advantages of laser soldering】

Laser soldering can be complemented operations, which are difficult / impossible with iron tip soldering, if carefully setting the heating conditions in advance for operation.

★Special Attributes of Laser Soldering

1. Contactless operation to circuit board which reduces physical damages
2. Stable soldering is acquirable and automation-able with efficient heating method and feeding solder.
3. Easy maintenance (mostly unnecessary)

4. Pinpoint soldering possible (suitable for micro soldering which the iron is unreachable due to high density)

The absolute advantage of laser soldering is its "non-contact action". It has no contact with circuit board or electronic parts, soldering is accomplished without any physical damages. Efficient and pinpoint heating is also additional advantage which is applicable for narrow and tight places. Furthermore, it needs less consumable materials such as iron tips, which significantly reduces daily maintenance workload.

【2 points to select laser or iron soldering】

Laser soldering is a relatively new technology, but is not a replacement of iron soldering. It's been already confirmed technic for soldering but it is significant to choose appropriate soldering methods and techniques by understanding the thermal exchange theories and applicability for specific objects.

Iron Soldering	Laser Soldering
Best for high heat capacity parts	Best for ultrafine parts
Easy to control soldering temperature during its operation	Possible to solder in narrow or intricate works.

Table 2 :Points for selecting between laser and iron soldering

Iron soldering makes physical limitation by the size of the iron tip as well as structure of electronic components. However, this is not an issue anymore for laser soldering. Laser soldering is well-suited for narrow and intricate works, where parts are almost touching each other in highly dense circuit board.

In contrast, an iron tip is suitable for soldering operation, which requires high heat capacity works with large components. Highly reflective materials makes hard laser to heat up due to its technical attributions. Thus, heat transfer mechanism of iron tip soldering is classic but still effectively accepted for manufacturing heat capacity components on a board.

【The expansion in laser technical utilization】

After successful laser soldering commercialization, the device has been adopted by electronic manufacturers such as smart phones, medical devices, and many others. At the same time, Japan unix soldering lab collecting data on safety, reliability, and fusion strength through actual inspections and evaluations, laser technology has been demonstrated its value to adopt for soldering operation. If you have any trouble regarding soldering, please contact us.

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Fig. 5 Laser Soldering System (left boxes and head)

Fig. 6 SCARA type laser soldering robot (right)

Youtube Japan unix channel:

Automatic Laser Soldering Robot

http://youtu.be/b2HNYxeGb48