ZEVAC

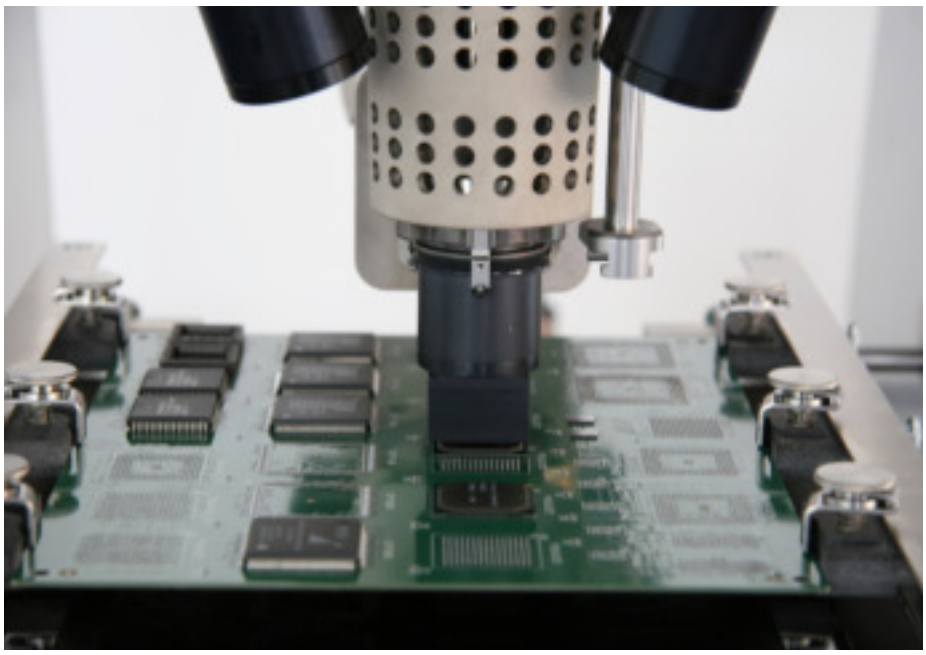
REWORK AND REPAIR

Benefits of hot gas

Swiss Engineering

HOT GAS VS. INFRARED REWORK

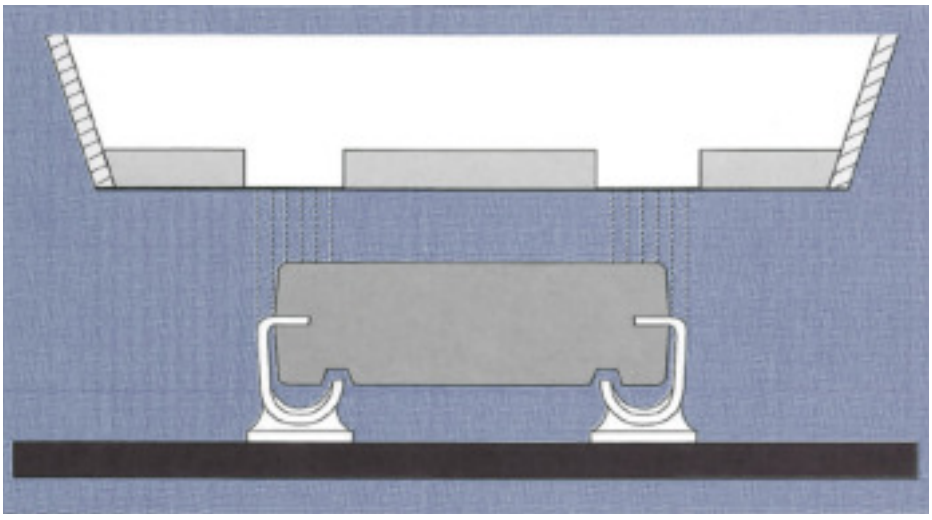
Confronting rework equipment requirements generally occurs amid changing PCB design another processes. The standard procedure to day cannot necessarily be used tomorrow.
Generally, the user has little or no actual experience with the rework equipment. Because of these elements, it is no surprise that rework and repair equipment purchases are often executed as a "quick fix" or "good enough solution" for the immediate problem.
The resulting selection can be limited to a few procedures or, in some cases, a one-time usage. Both make the solution a poor investment.
Current rework technology uses two basic energy sources; focused hot-gas and focused infrared (IR) light.
These sources focus energy (heat) through restricted openings or nozzles onto the solder joint. When selecting rework equipment, several factors must be considered, such as keeping the heat away from areas adjacent to the rework site an the SMT die. Other factors include the effect of heat on board warpage; material discoloration; complex designs and SMDs; the type of flux used ; and changed in the assembly process.
All these factor require the user to give extra consideration to the type of heating source and method of focusing the energy. Although system are classified as hot –gas or IR, not all system are equal in thermal performance or operation.



Hot gas head ONYX 29

INFRARED LIGHT

The IR method of work is based on IR production reflow. However, there is a problem: rework is not reflow.
Reflow production processes are extensively monitored, are broken into different heating zones and apply heat over the entire assembly. Rework modules are not this sophisticated and do not have to totally heat assembly. There are several types of IR emissions (lamp, diode and laser) and various methods of focusing the energy. IR rework system do not move air to heat the rework site and, therefore, do not have propensity to spread or move the flux into unwanted areas.
These systems are also known for a seemingly faster ramp rate and component removal cycle. However, changes in the assembly process, such as the addition of low solid fluxes or the use of a heat sensitive SMD, may require a change in assembly requirements. Figure 1 illustrates how IR energy (lamp emission) is focused on the PCB. Note that it is dependent on the height, the accuracy of restrictive openings and properly positioned plate. The rework process can be affected by uneven heating. Shadowing and heat transfer through the board material to



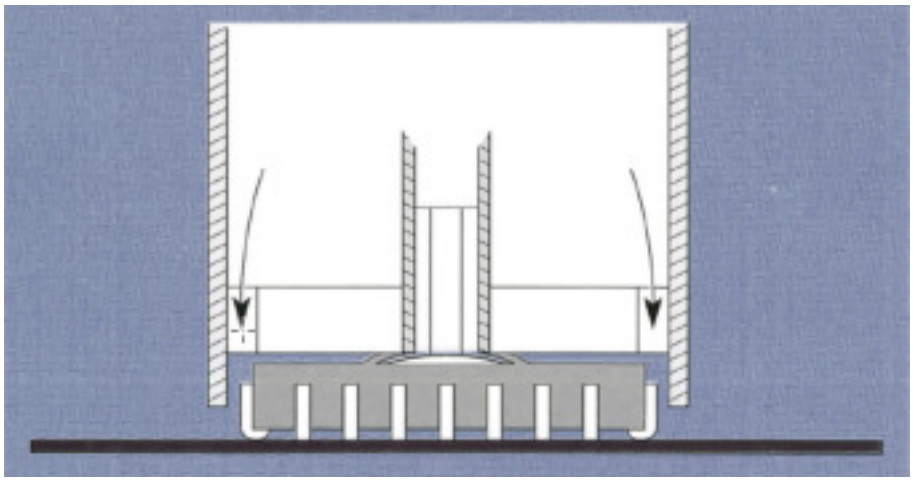
Focused IR energy

HOT GAS

This process heats the solder joints with directed hot gas (convection). Focused gas flow, through an engineered nozzle, can accurately concentrate heat on the solder joints, effecting neither the die nor neighboring components (Figures2).
Nozzle can be designed in a variety of layouts and can be made to meet demands of more complex assemblies. Not all hot gas systems are equivalent, and it is important to examine the heating source and gas focus design. These and other key elements should be analyzed when considering either a hot gas or an IR rework station.

HIDDEN SOLDER JOINTS

Some surface- mount devices have either totally hidden leas or unusual shapes that have a tendency to hide the leads. Some examples include surface- mount connectors, ribbon/Kapton cable connections, plastic sockets, TAB, COB and grid arrays.
IR rework conforms to the same principles as visible light. It is difficult, if not impossible , to angle the light to reach the hidden leads. With a properly constructed gas nozzle, it is possible to deflect the gas flow under the component to heat the leads.



Focused hot-gas flow

TEMPERATURE CONTROL

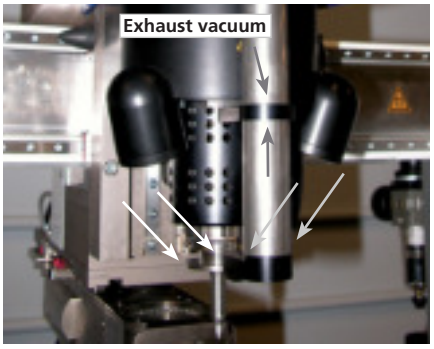
To the best of my knowledge, there is no reliable, self regulating temperature device that can control IR energy on rework systems. The most accepted means of control is to limit the exposure time. For lamp emissions to efficiently reflow solder, the energy source needs to operate at a high power. Regulating the energy source ma decrease the IR wave length and affect the reflow of the joints. Most hot gas system can be set up as closed loop, temperature controlled operations.
These regulate the temperature around 450°C. The typical processing temperature is 275°C+/-5°C.

NITROGEN ATMOSPHERE

While the use of nitrogen as the hot gas always been, available on some machines, it is how becoming more commonplace. System that integrate the use of this inert gas can reduce or, in some cases, even eliminate the use of flux.
In addition, consumption rates are so insignificant that it may not even affect the current in –house supply system (less than 1.9 scf is a rough approximation for normal intermittent usage). Added benefit is reduced to approximately 10 ppm.
The defect rate goes down, and a better quality solder joint results.
Nitrogen atmosphere prevent oxidation, reduce discoloration and bridging, shorten process times and lower the required process temperatures.

ENVIRONMENTAL CONSIDERATIONS

Our environmental sensitivity has compelled us to guard against
operator exposure to many elements. Clean, uncontaminated air in the work environment is an absolute necessity for the safety of the operators. Effect solder and flux fumes have on a person's heath is well documented. Both hot-gas an IR systems require an efficient vacuum system to remove these unhealthy fumes. Any specified vacuum system should include a filtration system that will purify the exhaust air.
Suppliers of quartz IR lamps warn against ultraviolet (UV) radiation emitted from lamps an suggest that "suitable protective shields, screening techniques or both" should be used to protect operator from exposure to electromagnetic radiation.



Fume exhaust

CONCLUSIONS

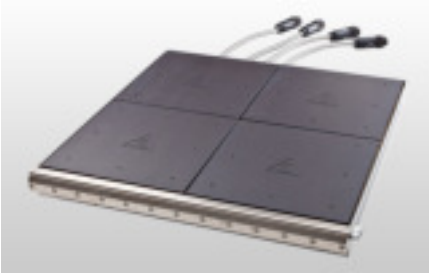
Rework is not an exact science. The very concept of it requires consideration of every aspect of the manufacturing process. Care must be taken when selecting rework equipment to ensure that it is not too complicated or too programmable. Either of these may intimidate the operator and waste valuable resources. Select a provider that is willing to provide the best solution and not just the equipment.
Talk to current users of the equipment you are considering. Find out if they had the chance to change the equipment, what would they change? Would they buy the exact same equipment again? How good is the service from the supplier? Last, but not certainly not least, ask for input from all of the rework operators in your operation. After all, they are the experts.

PREHEAT

There are two basic substrate categories: those with tremendous mass (aluminum substrates, high- pwer applications, copper cores, MCMs, etc.) and everything else. High mass assemblies require a preheat cycle in an oven, on a hot plate or with edge heaters—regardless of whether the method is hot gas or IR.

If the heat is localized on the bottom of the substrate, the heat may have difficulty permeating through to the top of surface on these high mass boards. This can lead to degration of the board material, which results in warpage, blistering or discoloration. When using IR System, botto, heating is essential to compensate for the variation of heat absorption by the assembly.

Most commercial applications are low in mass. With IR systems, bottom heat must be applied to ensure a constant rate of energy absorption. Hot-gas systems used on low-mass assemblies require only topside heating because the focused flow heats only the solder joint. Very little heat is introduced into the assembly.



Independently controlled 4-zone pre-heater

LESS THAN 20 MIL PITCH

Most of rework equipment suppliers claim removal, placement and reflow down 20-mil pitch. Even at that level, process results are a question of placement accuracy, operator skill and ease of operation. For some complex assemblies, equipment with advanced capability may be required. Below 20-mil threshold, it is easier to distinguish between rework equipment. One of the most critical factors is lead co planarity and its maintenance. Standard IR or hot-gas systems are not enough to ensure proper placement and soldering.

In most cases, additional solder must be added to rework site.

This can be accomplished through the use of a soldering iron, roller, preforms or the deposition of additional solder past.

In any case, there Is no guarantee that the solder deposition will be uniform, which adds to the co planarity issue.

A method that address this problem is hot bar soldering. This type of soldering has been adapted to hot-gas rework and is used to control lead position, prevent lead damage and compensate for solder height irregularity. AVEX Electronics has found that as lead centers decrease below 12-mil pitch, placement pressure must also be monitored. Hot-bar soldering is capable of pressure control.

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