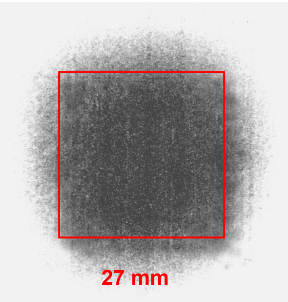
A. Uniform heating using controlled IR radiation

The ERSA IR Rework systems use medium wavelength IR radiators, emitting radiation in the range of 2 to 8 µm. The absorption/reflection ratio of these radiators is optimised for PCB manufacturing and rework thereby guaranteeing a minimal ΔT.

During the reflow process, the heat distribution for small components and large components is uniform. Temperature differences between a small adjacent chip and a large BGA, for example, can be reduced by the choice of the appropriate temperature profile and the optimal preheating time.

The patented aperture system of the ERSA IR top radiators **reduces** the irradiation of neighbouring components depending on their distance. A complete shielding, however, is possible as discussed below in part D.

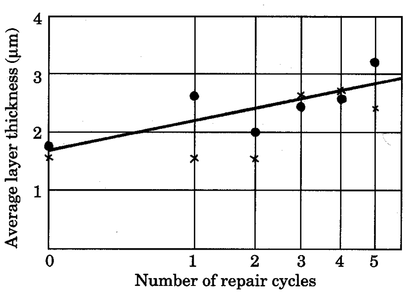


IR heat distribution over component borders
(source: ERSA GmbH, 1999)

B. SMT Production conditions for multiple reflow

During a typical reflow manufacturing process of a double sided SMT PCB, two reflow cycles or even up to three heating cycles are standard. Industry standards and scientific data accept this multiple reflow process as having absolutely no measurable negative effect to the long term reliability of the soldered connection.

The most obvious effect of too many and/or too hot heating cycles is the growth of the intermetallic tin-copper layers. As seen in the table below, during as many as five repair cycles, the intermetallic layer increases by only 1µm.[1] This increase, as discussed in part C below, however, is inconsequential to the joint stability.



(source: Klein Wassink, 1995)

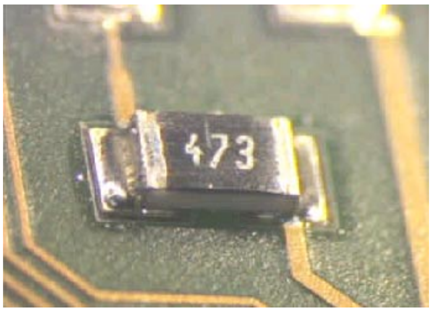
[1] See „Manufacturing Techniques for Surface Mounted Assemblies", R.J. Klein Wassink and M.M.F. Verguld, Chapter 13

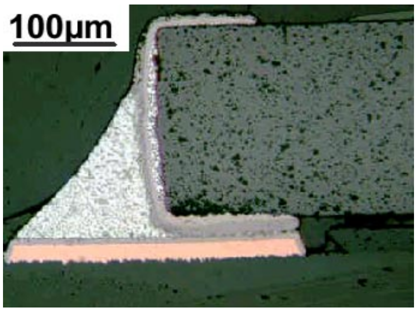
C. Tensile strength during repeated reflow processes

Studies of several institutes show that the intermetallic phase inside a solder joint does **“not show critical growth while using suitable reflow process windows on the PCB”** [2]. This statement is valid for standard solder alloys as well as lead free alloys, and is documented below..

pad surface	solder alloy	time @ 250 °C	PCB phase thickness [µm]	tensile strength [N]
HAL	SnPbAg2	**1 min**	**2.2**	**56**
		10 min	**4.0**	**54**
		60 min	**4.7**	**17**
NiAu	SnAg3.5	**1 min**	**5.4**	**41**
	(Lead Free)	**10 min**	**7.2**	**38**
		60 min	**9.9**	**12**

Tensile strength of a R0603 chip (source: ISIT)





R0603 chip and cross section (source: ISIT)

The above table clearly underscores the fact that multiple reflow processes occurring as long as 10 min. show no critical reduction in the solder joint strength!

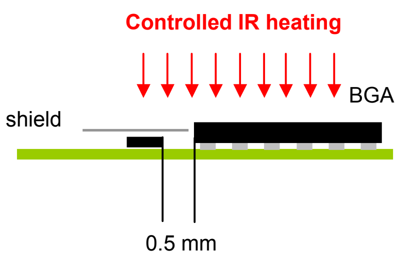
The secondary heating of small chips adjacent to a BGA being reworked is not at all problematic as long as the proper reflow process parameters are respected and the adjacent component is not being moved or ”blown away” in the process.

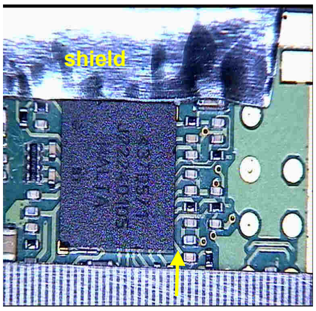
[2] Fraunhofer Institut Siliziumtechnologie, ISIT; „Phasenwachstum und Scherfestigkeit von Lötstellen“, Feb. 2002

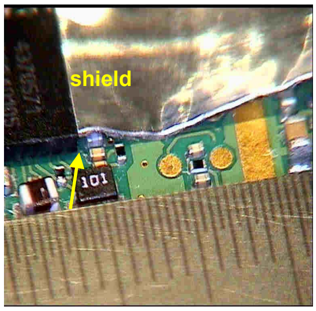
D. Protection of heat sensitive devices where required

Although it should now be clear that controlled adjacent heating is in general non-problematic, there are surely cases where this could be undesirable. The choice of the heating technology used in a rework system will determine the ultimate ability to completely control adjacent heating in order to protect heat sensitive devices.

The ERSA IR Rework systems incorporate an advanced technology for safe SMT rework which can completely protect heat sensitive components. The IR radiation can be shielded by the use of heat resistant tape or aluminium foil, thereby keeping the solder joint temperature of an adjacent chip well below it’s melting point, even at a distance of 0.5 mm! This level of heat control during rework is possible using IR technology.



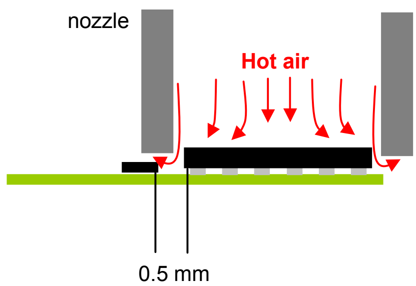


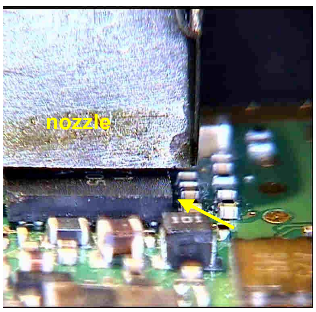


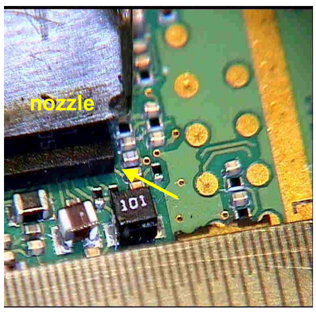
(source: ERSA GmbH)

While hot air or convection is industry standard for an enclosed reflow oven, controlling the heat in an open rework environment is both difficult and limited, and depends greatly on the hot air nozzle construction.

A method of protection of heat sensitive devices is not possible on most hot air systems where the adjacent device is closer than 3 mm. For those hot air systems where the nozzle is required to be placed flush against the PCB surface in order to have a proper convective atmosphere, the nozzle wall cannot fit into this small gap. For those systems where the nozzle does not contact the PCB, the escaping hot air will most probably overheat the adjacent device.







(source: ERSA GmbH)