Recommendations for the Design of Assemblies to be Soldered Selectively (Selective Miniwave Soldering)

The following data is based on projects which already were realized. Required clearances etc., however, may differ depending on application.

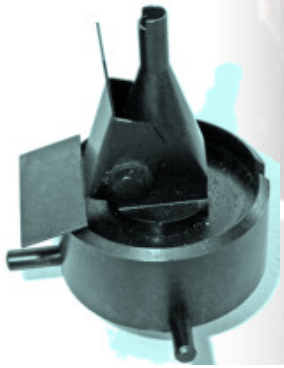
Selective Wave Soldering: Two Basic Technologies

miniwave soldering with single nozzle

- all solder joints are approached successively
- cycle time: approx. 1 min–10 min depending on the number of joints
- high flexibility – long cycle time

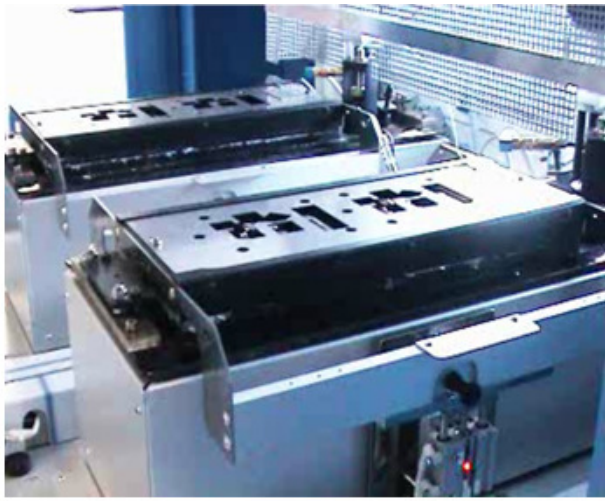
wetted nozzle

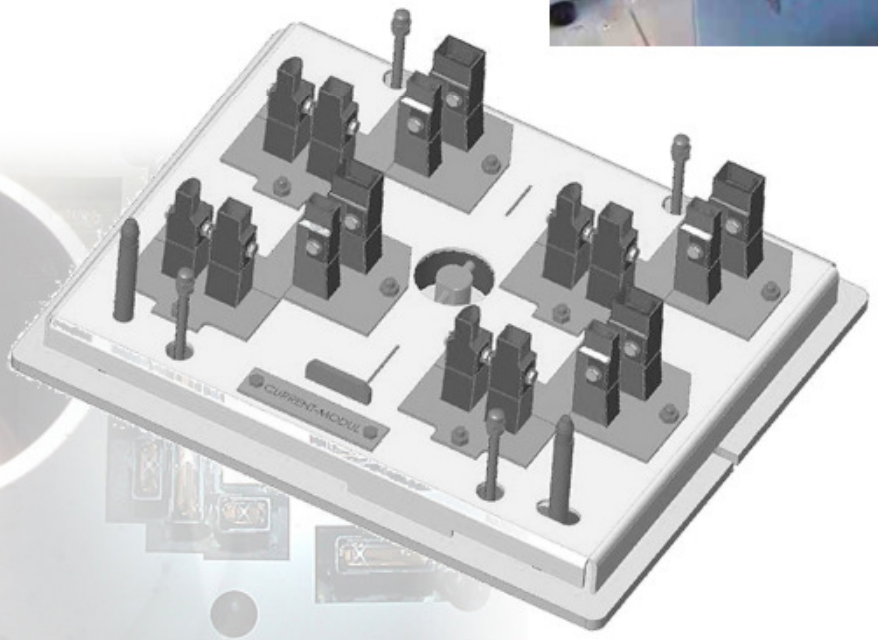
not wetted nozzle



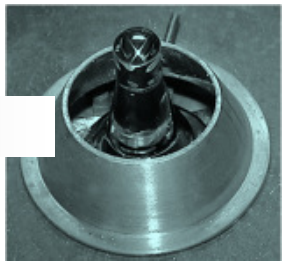
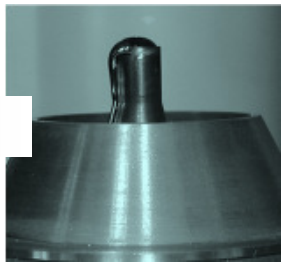
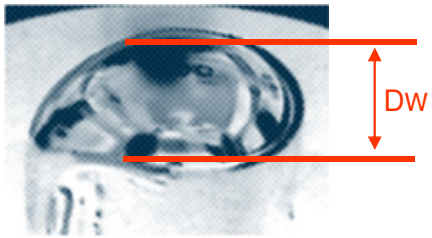
miniwave dip soldering with multi-nozzle tool

- all solder joints are processed simultaneously
- product-specific nozzle tool
- cycle time: approx. 20–40 sec.
- low flexibility – short cycle time

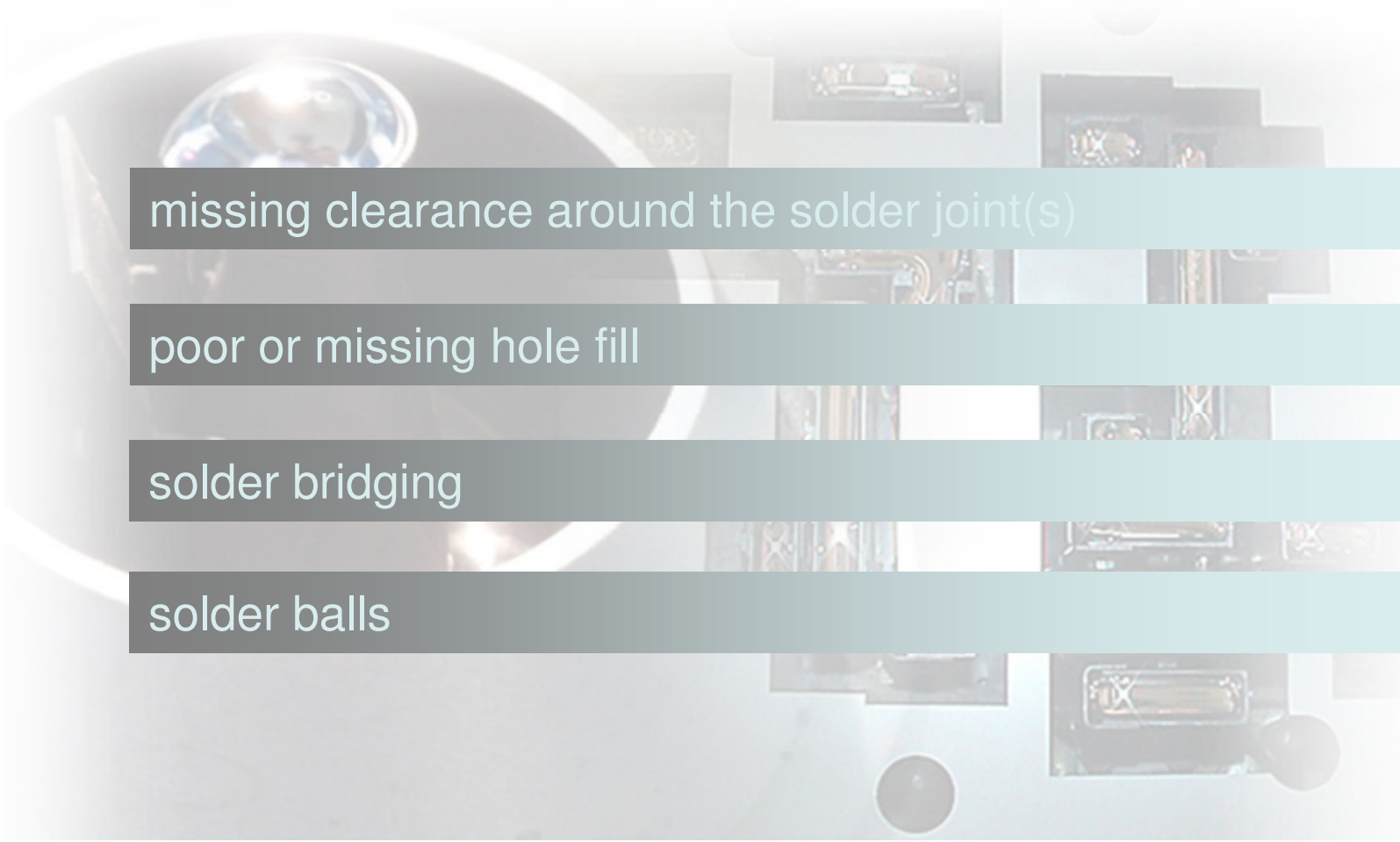




Selective Wave Soldering: Single Miniwave Variants

	wetted nozzle	not wetted nozzle
		
solder flow	solder flows to all sides (not directed) assembly may be positioned individually	solder flow directed to one side assembly is alligned according to the solder nozzle (rotatable gripper)
characteristics	• pitch min. 1.27 mm for pin rows no angle required • wetting width depending on: - outside nozzle dimensions - pump rotation speed - wear of nozzle material - condition of the nozzle  solder flow with optimum wetting solder flow when wetting is not optimal	• pitch min. 1.27 mm for pin rows (pitch of 2.54 mm or less to be soldered with an angle) • wetting width precisely defined through the nozzle contour 
maintenance	• require intensive maintenance (once per shift) • limited lifetime, particularly with lead-free alloy <u>available maintenance technology from SEHO:</u> - automatic refresher unit with dispenser - manual refresher pen  	• **maintenance-free** • nozzles constantly show a **stable and reproducible** flow pattern • **no wear of solder nozzles**, even in lead-free processes

TYPICAL ISSUES IN A SELECTIVE SOLDERING PROCESS WHICH CAN BE INFLUENCED THROUGH THE BOARD DESIGN



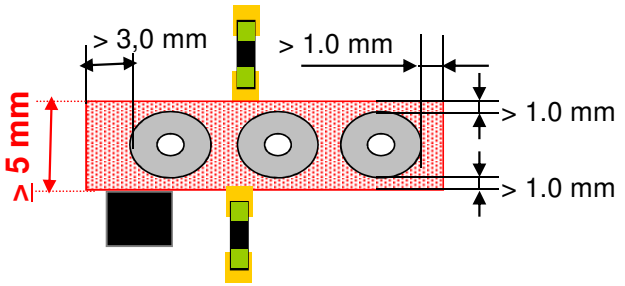
- missing clearance around the solder joint(s)
- poor or missing hole fill
- solder bridging
- solder balls

Clearance around the Solder Joint(s)

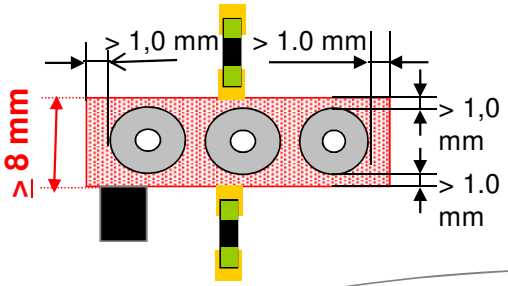
Clearance around the solder joint(s): Areas without Components

miniwave soldering with single nozzle

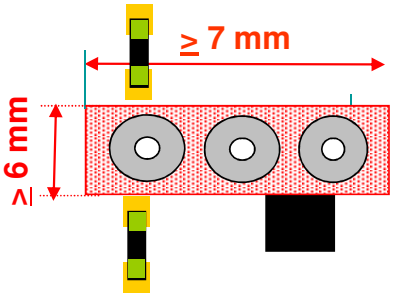
not wetted nozzle



wetted nozzle

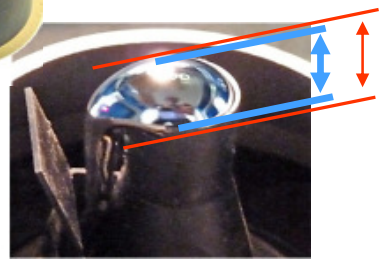


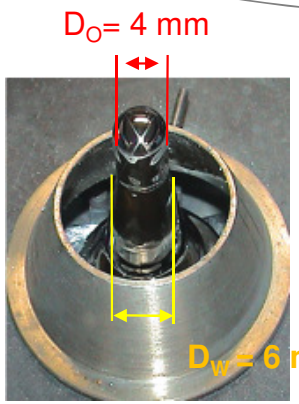
multi-nozzle dip soldering



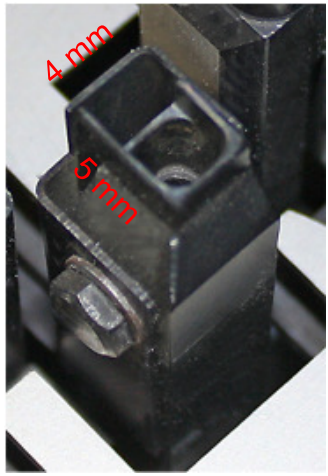
area without SMDs or other components, if possible
even without vias or any measuring points –
vias or measuring points located in this area will be wetted!

reason: smallest possible solder nozzle diameter



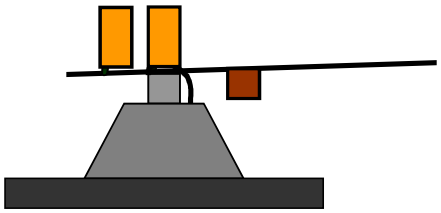


reason: smallest possible solder nozzle dimension



Clearance around the solder joint(s): max. Component Height on Soldering Side

miniwave soldering with single nozzle



single miniwave soldering in a drag process requires consideration of the distance between the solder joint and a neighbored component higher than 10 mm [0.39“] on the soldering side

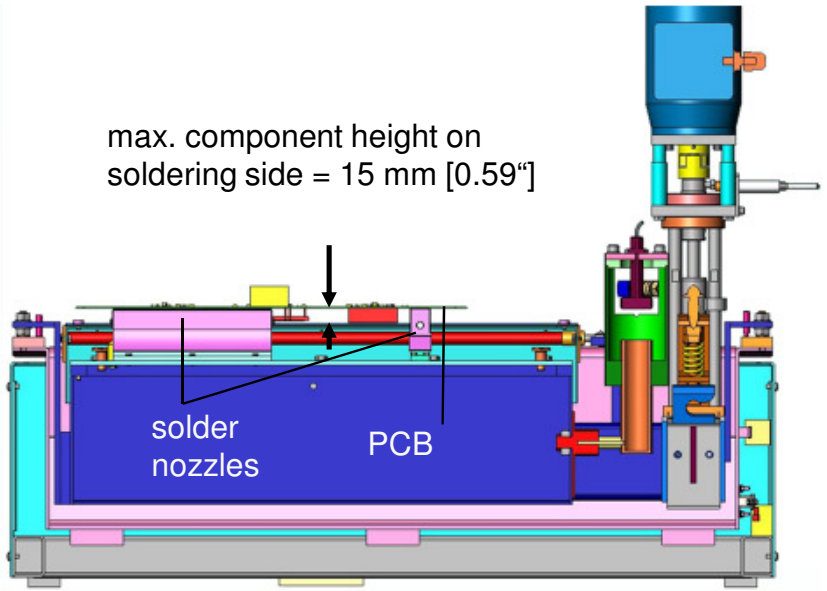
rule of a thumb for components higher than 10 mm:

height of component ≤ distance to solder joint

max. component height with standard nozzles: 25 mm [0.98“]

nozzles for higher components available upon request

multi-nozzle dip soldering

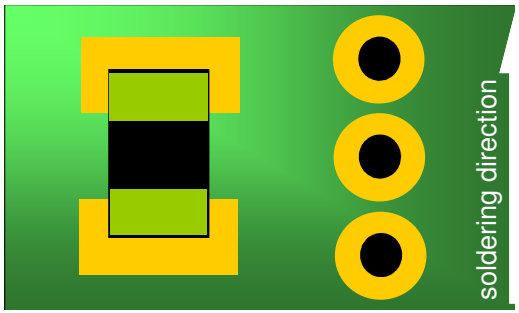


special solutions for higher components available as well

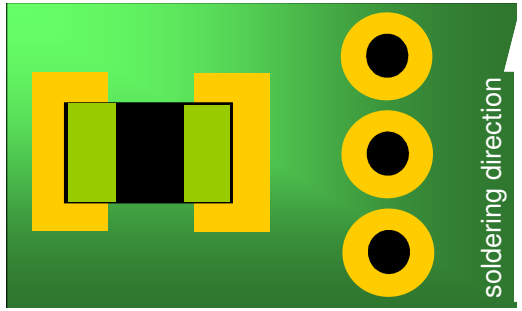
Clearance around the solder joint(s): Alignment of Neighbored SMDs

miniwave soldering with single nozzle: **alignment of SMD components**

(for very small distances to neighbored pin row)



parallel alignment



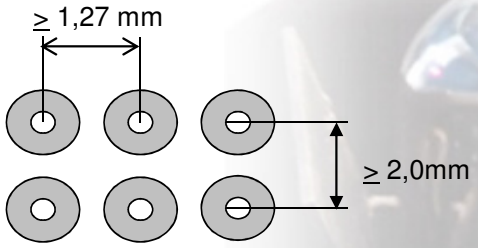
inline alignment

Avoidance of Solder Bridging

Avoidance of solder bridging: Pitch between the Component Pins

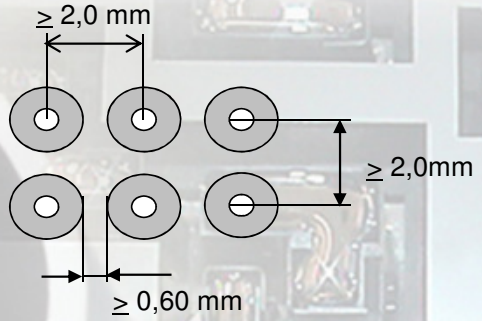
miniwave soldering with single nozzle

minimum pitch: ≥ 1.27 mm*

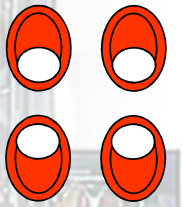


multi-nozzle dip soldering

minimum pitch: ≥ 2.0 mm



- round pads and round pins should be preferred (instead of squared)
- use oval pads in case of very small remaining pad area

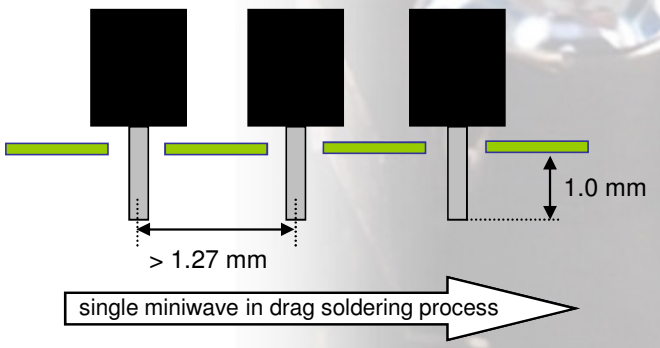


* To ensure a bridge-free miniwave soldering process for pin rows with a pitch smaller than 2.2 mm, special attention has to be payed to board design and wettability of the used material. In this case, pin length should not be more than 1 mm. We recommend soldering tests. Eventually, wetted solder nozzles have to be used.

Avoidance of solder bridging: Excess Length of Component Pins

miniwave soldering with single nozzle

excess length of pins: approx. 1.0 mm

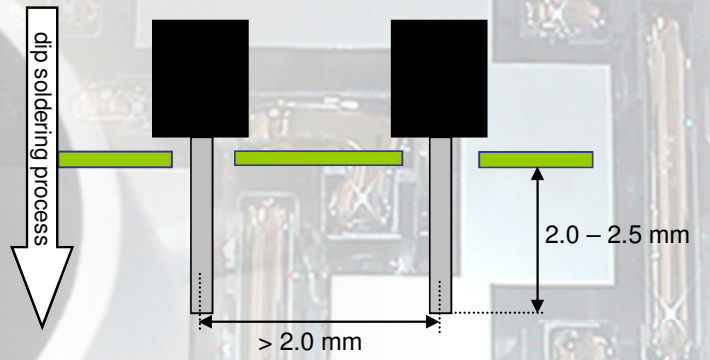


- moving board and / or soldering angle improve peel-off to reduce bridging
- pad size to be adapted to pin length

in case of short excess length of pins and large pads there is a risk of poor meniscus formation and ball-shaped solder joints

multi-nozzle dip soldering

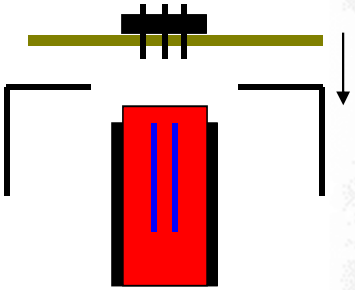
excess length of pins: 2.0 - 2.5 mm

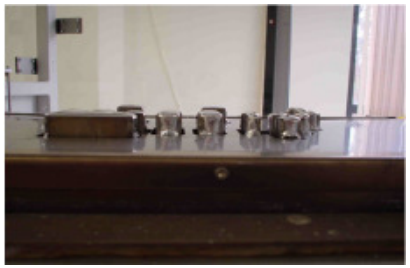


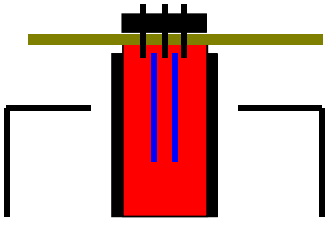
- peel strength of the solder is enhanced with a longer component pin which pulls the solder away from the solder joint to reduce risk of bridging
- simultaneously energy transfer rate is improved

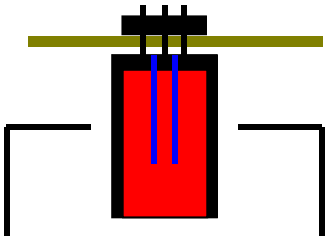
SEHO Design Measures to Avoid Solder Bridging

multi-nozzle dip soldering: Solder Nozzle Design with Debridging Knives









The board moves over the soldering unit and gassing hood. The flowing nitrogen can be used as additional preheat station.

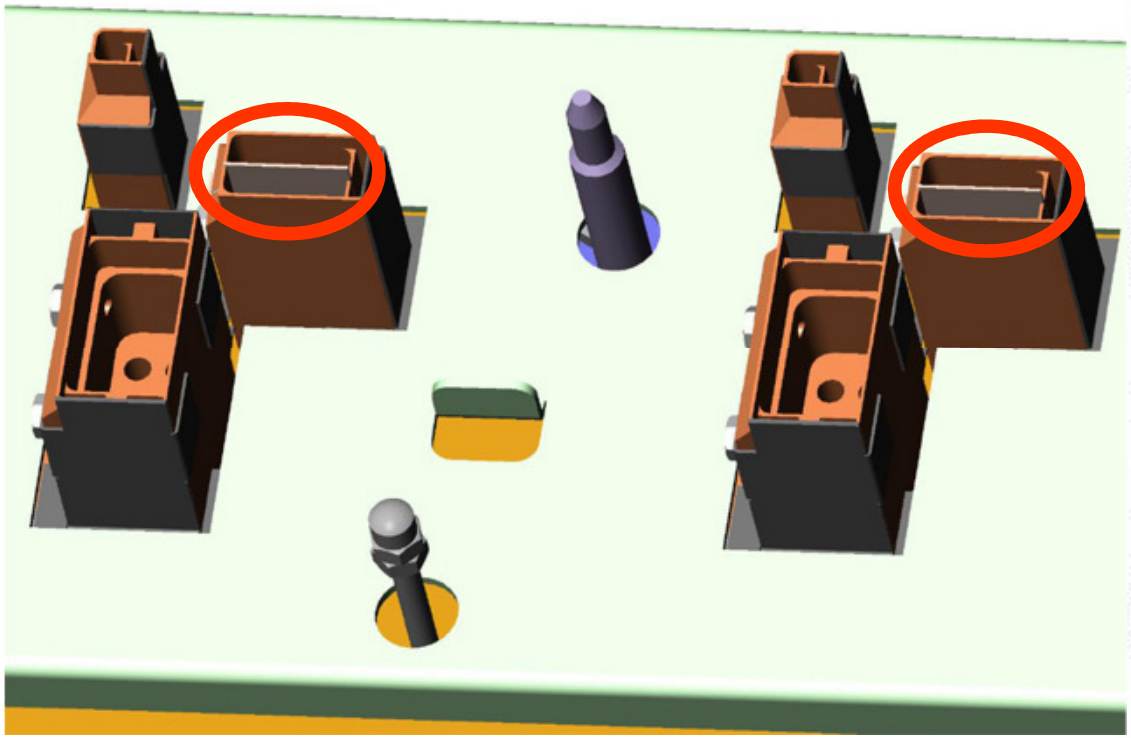
The gassing hood moves down. Afterwards the PCB is brought into the soldering position. Positioning mostly is supported by tooling holes.

After the dwell time the solder level drops down, while the board keeps its position and the debridging knife drains the solder, i.e. surplus solder alloy flows back into the nozzle.

SEHO Design Measures to Avoid Solder Bridging

multi-nozzle dip soldering: **Solder Nozzle Design with Debridging Knives**

perfect peel-off, even with solder alloys showing difficult flow properties



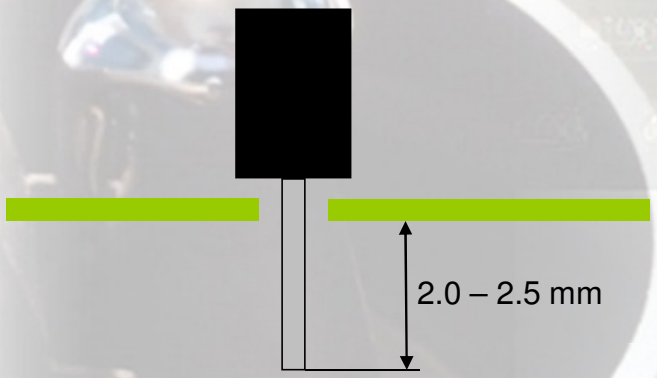
minimum use of wear parts

complete tool design as wear part – **costs!**

Improved Hole Fill

Improved hole fill: Excess Length of Pins

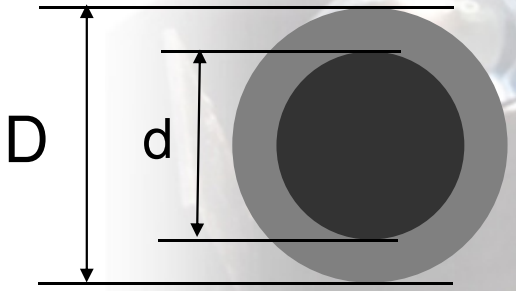
recommended excess length of pins: 2.0 – 2.5 mm



longer pins are dipped deeper into the liquid solder which improves the energy transfer rate

Note: For miniwave soldering processes please consider the remarks on page 10 (pitch between the component pins)! There is a risk of bridging for pin rows with a pitch ≤ 2.54 mm and long excess length of pins. Therefore, these applications require short excess length of pins (approx. 1 mm).

Improved hole fill: Ratio between Pin Diameter and Via



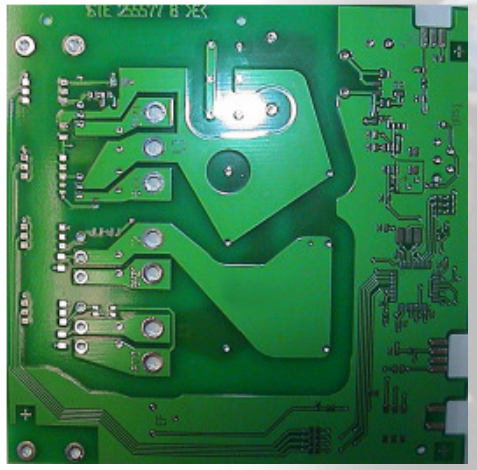
rule of a thumb:

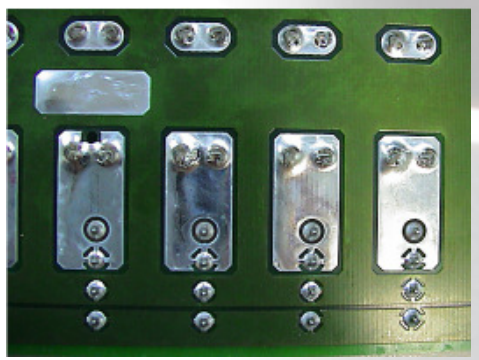
D = d + 0.2...0.4 mm

- ratio too large: no capillary action
- ratio too small: poor flux penetration

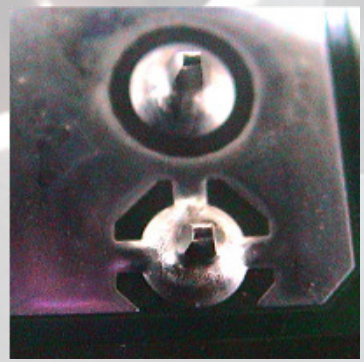
Improved hole fill: Connection of Copper Areas

thermal decoupling





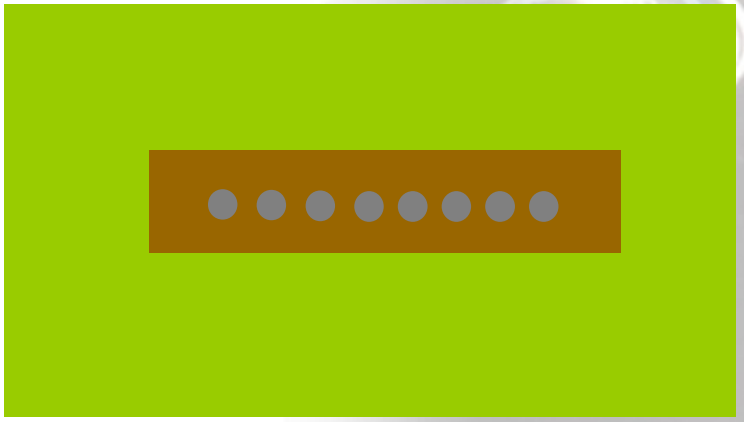
negative example:
heat is directly withdrawn from the pad



positive example:
thermal energy will not completely be withdrawn to the strip conductor, but will be hold for a longer time at the pad

Improved hole fill: Open Areas

avoid solder resist close to the solder joint



- helps to keep thermal energy at the solder pad
- also helps to avoid solder balls

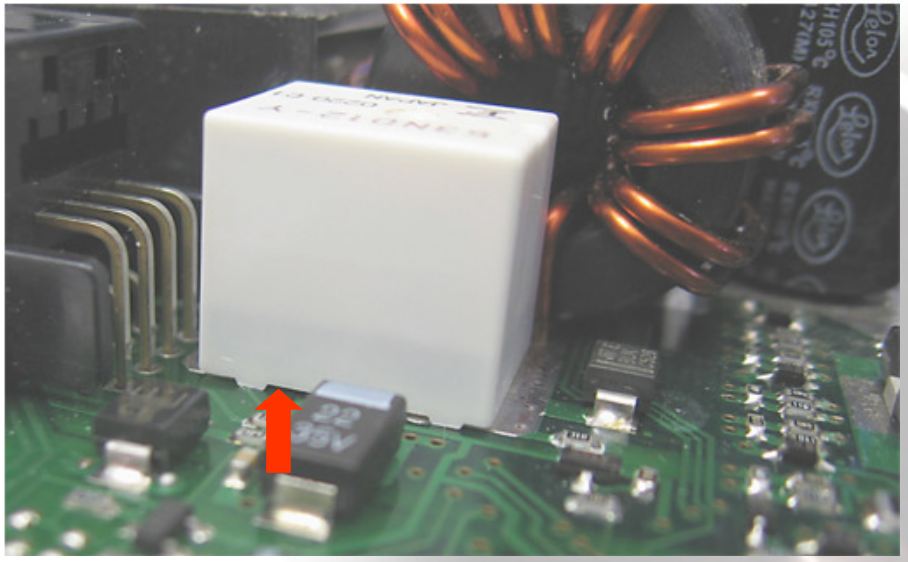
Improved hole fill: Enlarged Pad Area

... or oval pad form

keeps thermal energy longer at the pads

pin length should be expanded simultaneously to allow proper formation of a meniscus

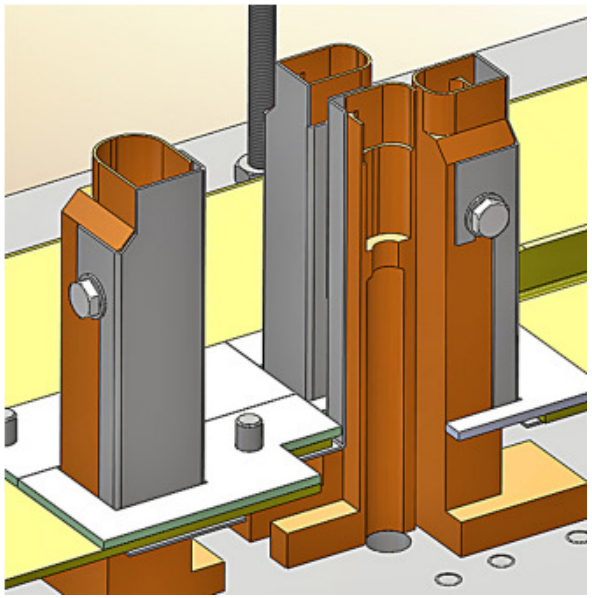
Improved hole fill: Gap between Component Housing and PCB



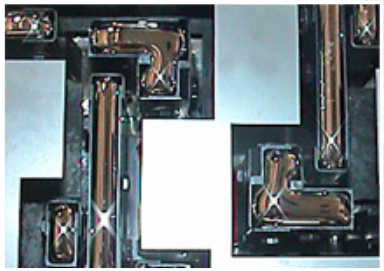
a gap between the component housing and the PCB material is required to allow the solder to soar through the via and form a meniscus at the top side

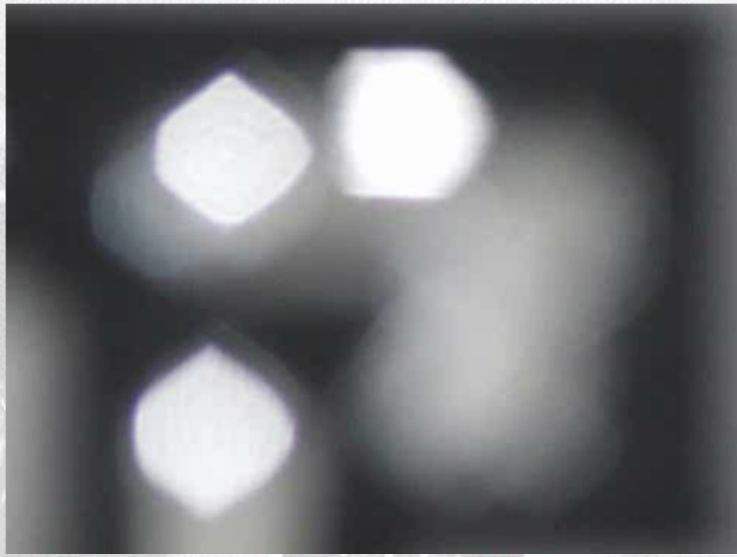
SEHO Design Measures to Improve Hole Fill

multi-nozzle dip soldering: **solder nozzle design with improved energy transfer**



flowing solder waves





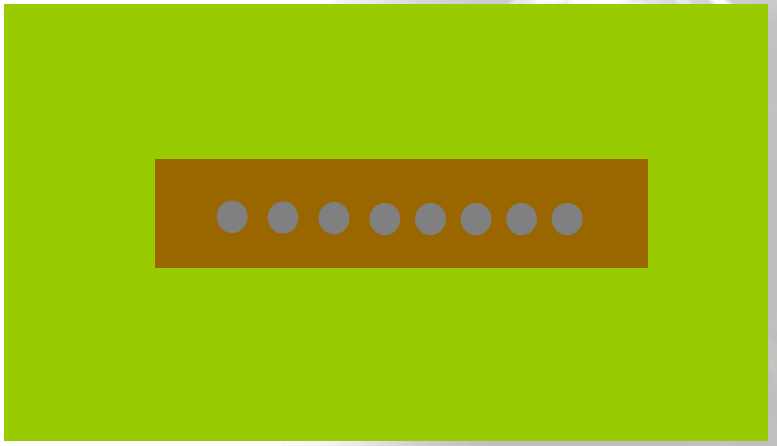
Features

- the solder alloy does not cool down during the contact phase
- short flow ways
- fresh and correctly heated solder alloy is supplied continuously
  - no filling problems, even in case of high-mass pins or connections
  - no filling problems at pins with connection to inner layers
  - no filling problems at pins located at the outer edges

Minimum Solder Balling

Minimum solder balling: Open Areas

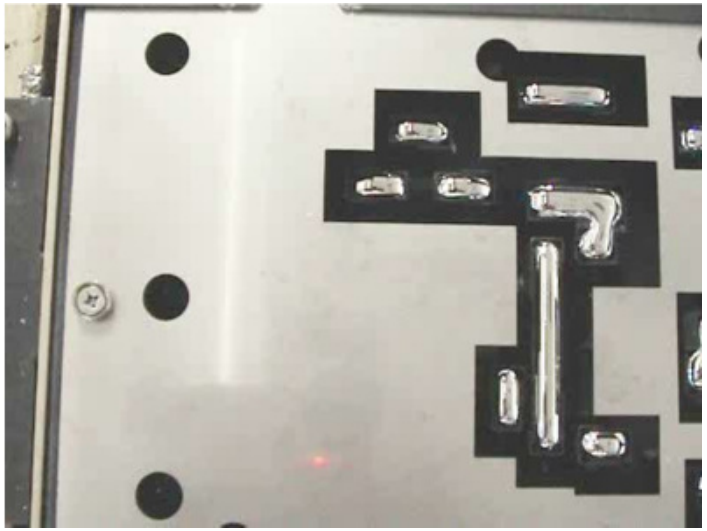
avoid solder resist close to the solder joint



- avoids solder balling
- also helps to keep thermal energy at the solder pad to improve hole fill

SEHO Design Measures to Reduce Solder Balling

multi-nozzle dip soldering: **inside flowing solder nozzles**



directed solder flow and additional cover avoid solder balling

cover to avoid solder balling