

ETF2017

Hand soldering and IPC Standards



Handsoldering using suitable materials,
methods and defined acceptance criteria

What do You use...

- **Solder**
Alloy
Flux
Melting temperature
- **Methods**
Soldertip temperature
Process steps
- **Rework**
External flux
- **Acceptance criteria**

Think about this and lets try to pass the solder-bridge...

About...

- **Claus Mølgaard**

Radiomechanic – Long time ago...

Electronics Engineer (Analog)

Audio Note UK

ISO9001 Leadauditor

- **Current**

ALPHA-elektronik A/S Næstved DK

Qualitymanager

Certified IPC Trainer (J001/A610)

IPC-TGN Revisioning and translations

2016: ALPHA-elektronik First company

outside USA/China to achieve

IPC Validation Service Certification

<http://www.ipcvalidation.org/html/validation-services/qml-001-610.htm>



- **IPC J-STD-001**
Materials, methods and acceptance criteria
- **IPC-A-610**
Visual acceptance requirements
- **IPC Standards overview**
Shortform:
<http://www.hytekaalborg.dk/da/ipc-standarder>
Spectree (ipc.org):
http://www.ipc.org/4.0_Knowledge/4.1_Standards/SpecTree.pdf

Wetting

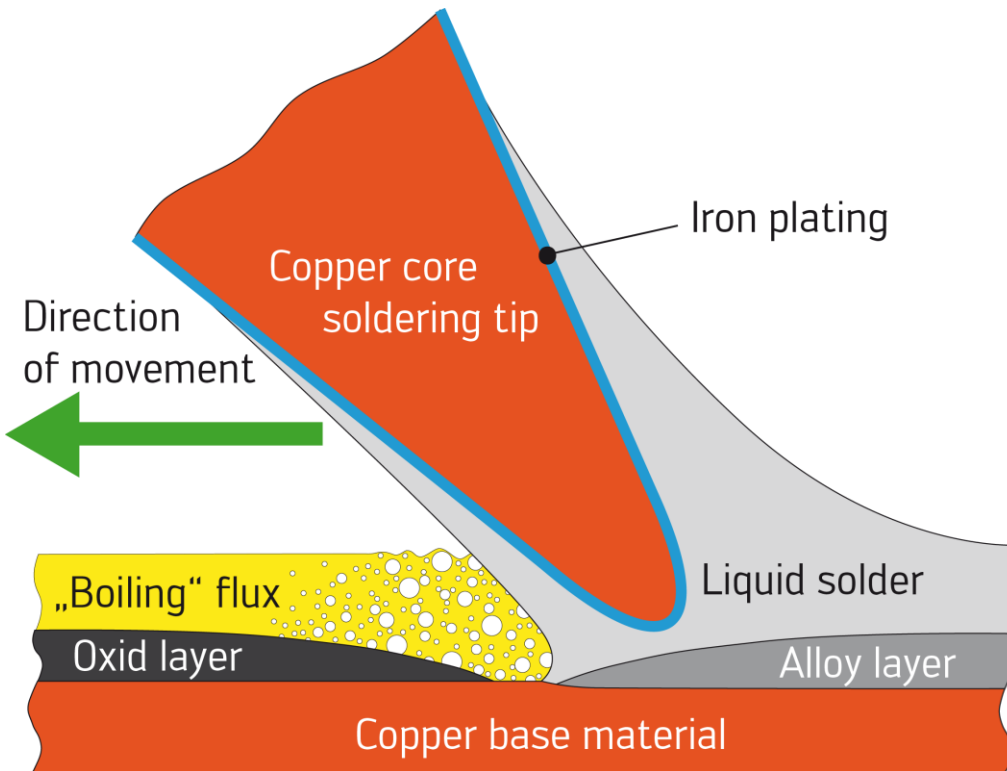
The most important factor of a soldering

Basic requirement is solderability of parts to be soldered

- a) The **wetting ability** depends on the soldering surface, soldering temperature and activity of the flux
- b) The **soldering heat requirement** grows with the heat capacity and the mass of the soldered parts
- c) The **soldering heat resistance** of the materials limits the soldering process in duration and maximum temperature

Construction, Material and Process have to match each other!

Soldering basics: Creation of a soldering joint



- A hot tip, wet with solder, touches the base material and heats it up.
- The flux from the soldering wire “boils”, it becomes active and removes the oxide layer from the copper and the solder completely (corrosive action).
- The liquid solder reacts with the copper surface of the base material and a growing layer of an intermetallic phase is created.
- The copper core of the soldering tip is protected against quick leaching (corrosion) by an iron plating.

Acceptance criteria of a soldering joint

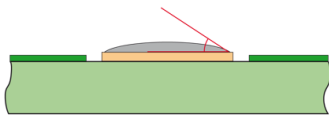
Qualification of the wetting:

Contact angle

$< 90^\circ$

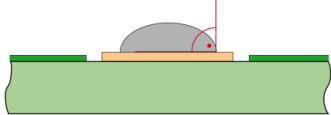
$= 90^\circ$

$> 90^\circ$



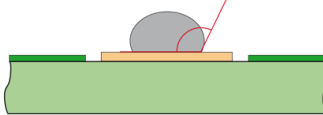
acceptable

Good wetting, solders spreads well, **flat** (acute) contact angle



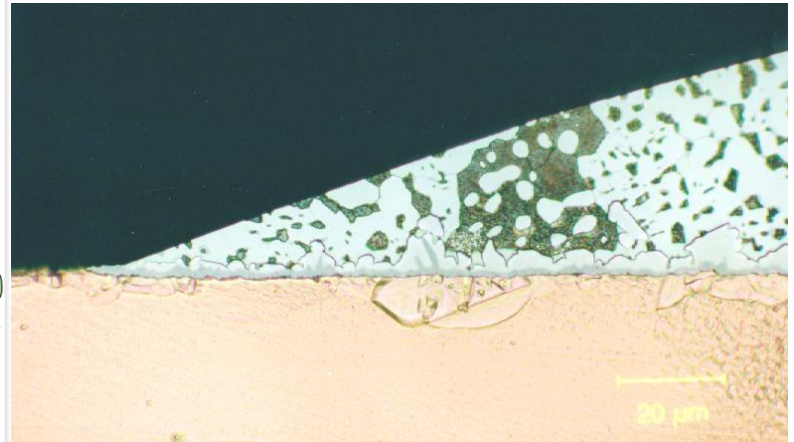
acceptable

Wetting still successful, Solder spreads, **maximum 90°** contact angle

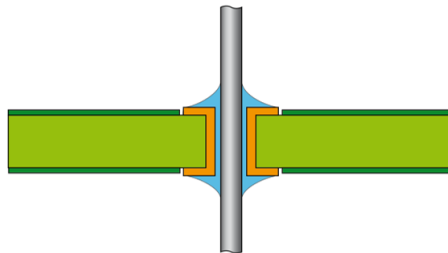


failure

Non-wetting
Solder doesn't spread, **obtuse** contact angle



Ideal soldering joint geometry



Ideal joint geometry THT



Ideal joint geometry SMT

Solder

- **Solder metal**
Wet all parts AND form intermetallic bond between solder and parts
- **Flux**
Assist heat transfer; clean parts;
Protect solder and parts from oxidation
- **Alloy elements?**
Tin (232°C); Lead (327°C)
Silver (961°C); Copper (1084°C)
- **Alloy melting temperature**
Eutectic or plastic range?

Solderalloy

- **Melting temperature**
Alloy elements; Eutectic or plastic range?

Alloy	MP [°C]	Comment
SN100C	227	Unleaded (RoHS)
SAC305	217-221	
Sn63Pb37	183	Good enough for Space!!!
Sn62Pb36Ag2	179	

Flux – Types and requirements

- **No-Clean examples**
Rosin (ROL0)
Resin (REL0)
- **Low residue**
- **Highly activated**

10.6.1 Cleanliness – Flux Residues

The flux classification (see J-STD-004) and assembly process, i.e., **no-clean**, clean, etc., need to be identified and considered when applying these criteria.



Figure 10-91

Target – Class 1,2,3

- Clean, no discernible residue.

Acceptable – Class 1,2,3

- No discernible residue from cleanable fluxes is allowed.
- Flux residues from no-clean processes may be allowed.

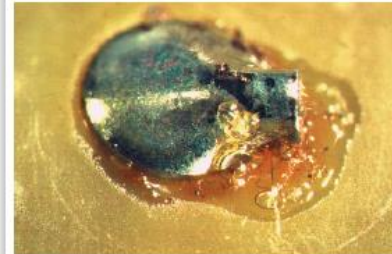


Figure 10-92

Defect – Class 1,2,3

- Discernible residue from cleanable fluxes, or any activated flux residues on electrical contact surfaces.

Note 1: Class 1 may be acceptable after qualification testing. Check also for flux entrapment in and under components.

Note 2: Flux residue activity is defined in J-STD-001 and J-STD-004.

Note 3: Processes designated "no-clean" need to comply with end-product cleanliness requirements.



Figure 10-93

Handsoldering – Basics

- **Soldertip**
MUST be wettable before soldering starts
- **Soldertip temperature**
Use lowest possible temperature!
Minimum temperature: Solderalloy
Maximum temperature: Parts and flux

Suggested soldertip temperature range:
UnLeaded: 340-365°C
Leaded: 280-330°C
- **Soldertip size**
Use biggest possible soldertip

Handsoldering – Suggested Methods

- **Heat all parts**
Place soldertip in good contact with all parts to be soldered
- **Tap solder on parts to verify when soldertemperature is reached**
- **Add solder to parts until acceptable solderfillet is reached**
DO NOT add solder to soldertip!!!
- **Remove solderwire AND soldertip simultaneously**
DO NOT heat the soldering any further
– RISK of burning the flux and creating solderpins

Soldertip maintenance

- **Clean immediately before soldering**
- **Leave solder on tip when placed in holder**
Also before switch off.
- **Use damp sponge to clean of solder and flux**
MUST use demi water – damp NOT wet
- **Use brass/bronze sponge to clean off any oxidation**
May need to be repeated several times – until tip is wettable
- **Change between Leaded and Un-leaded (RoHS)**
OK!- “Wash” with new solder 3 times – good to go!
- **Do NOT use tip cleaner/activator**
Too aggressive flux! Better: Change tip 😊

Solder rework

- **Definition: Repeating same or similar process**
- **USE external flux**
Never reheat a solderjoint without adding flux
- **Apply external flux**
Dip solder in liquid flux
Apply with syringe
Apply with flux pen ie BON-PEN
- **Compatibility**
All flux **MUST** be compatible to avoid problems with the corrosion and conductive nature of flux residues

Links

- **Google search**
Handsoldering training
IPC Training
- **NASA**
<https://workmanship.nasa.gov/lib/insp/2%20books/frameaset.html>
- **ESA**
<https://escies.org> (ECSS-Q-ST-70-08C)
- **Rework**
<http://www.circuitrework.com/guides/guides.html>
- **IPC**
ipc.org

Next ETF - Suggestion

- **Handsoldering training**
- **Handsoldering competition**

- **Any questions/comments?**

- **Thanks for your attention**