Solder plus Support

# WS488 WATER SOLUBLE SOLDER PASTE

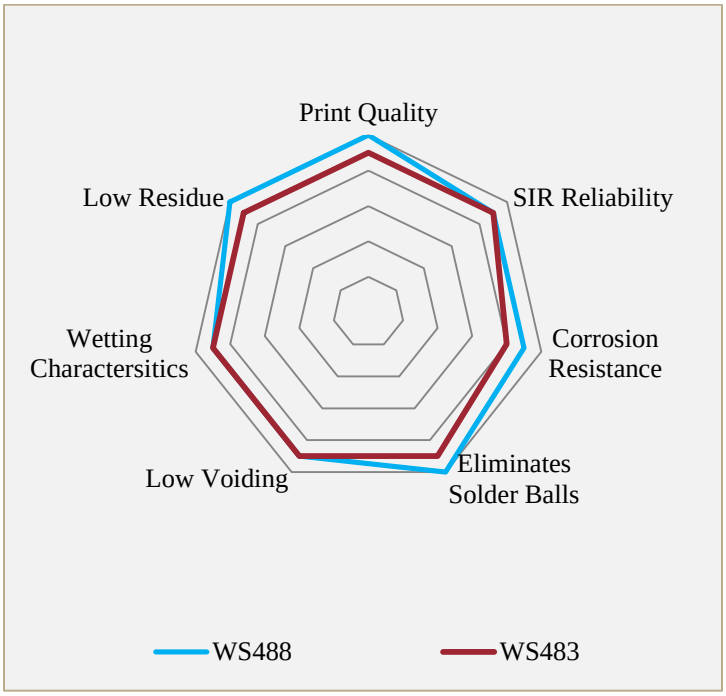
## FEATURES

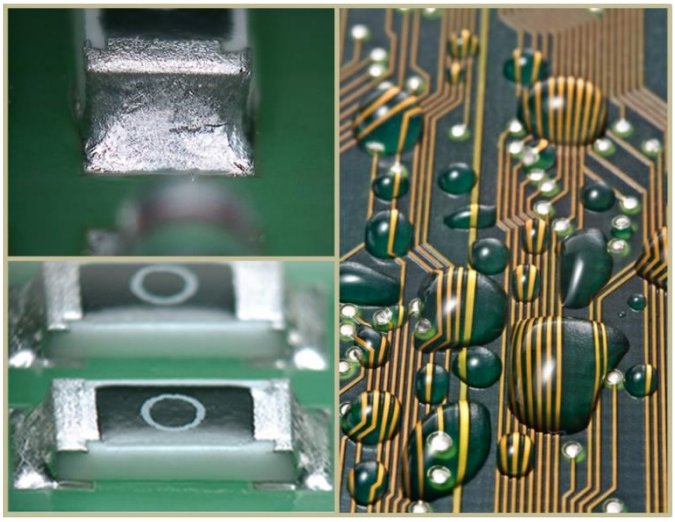
- Excellent Wetting
- Extended Cleaning Window
- Superior Slump Resistance
- 8 Hour+ Stencil Life
- Wash With Water Alone
- Low Foaming

## DESCRIPTION

AIM's WS488 water soluble solder paste has been engineered for powerful wetting performance on all solderable electronic surfaces, components, assemblies, and substrates. WS488 offers robust environmental tolerance, excellent print characteristics and 8+ hours of stencil life. WS488 has been developed to provide stable performance with all leaded and lead-free alloys. WS488 highly soluble residues are easily removed in plain water, even under low stand-off components. This all-purpose water soluble product was created to meet the industry's demand for a consistently reliable water soluble solder paste.

## CHARACTERISTICS



## HANDLING & STORAGE

| Parameter | Time | Temperature |
|---|---|---|
| Refrigerated Shelf Life | 6 Months | 0°C-12°C (32°F-55°F) |

Do not add used paste to unused paste. Store used paste separately; keep unused paste tightly sealed with internal plug or end cap in place. See AIM's paste handling guidelines for further information.

## CLEANING

Pre-Reflow: AIM DJAW-10 effectively removes WS488 solder paste from stencils while in process. DJAW-10 can be hand applied or used in under stencil wipe equipment. DJAW-10 will not dry WS488 and will enhance transfer properties. Do not over-apply DJAW-10. Do not apply DJAW-10 to stencil topside. Isopropanol (IPA) is not recommended in process, but may be used as a final stencil rinse.

Post-Reflow Flux Residue: WS488 residues can remain on the assembly after reflow for up to 2 weeks without corrosion. Cleaning is mandated and can be performed in plain water following with a final rinse in DI water.





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## REFLOW PROFILE

Detailed profile information may be found at http://www.aimsolder.com/reflow-profile-supplements. Contact AIM for additional information.

## PRINTING

| Recommended Initial Printer Settings – Dependent on PCB and Pad Design | |
|---|---|
| Parameter | Recommended Initial Settings |
| Squeegee Pressure | 0.10-0.30 kg/cm (.6 - 1.7 lbs/In.) of blade |
| Squeegee Speed | 12-150 mm/sec (.5-6”/sec) |
| Snap-off Distance | On Contact 0.00 mm |
| PCB Separation Distance | 0.75 - 2.0 mm |
| PCB Separation Speed | Slow |

## TEST DATA SUMMARY

| Name | Test Method | Results | |
|---|---|---|---|
| IPC Flux Classification | J-STD-004 | ORM1 | |
| IPC Flux Classification | J-STD-004B 3.3.1 | ORM1 | |
| **Name** | **Test Method** | **Typical Results** | **Image** |
| Copper Mirror | J-STD-004B 3.4.1.1 IPC-TM-650 2.3.32 | M = < 50% Breakthrough |   |
| Corrosion | J-STD-004B 3.4.1.2 IPC-TM-650 2.6.15 | Minor | Before  After  |
| Quantitative Halides | J-STD-004B 3.4.1.3 IPC-TM-650 2.3.28.1 | 0.07% Typical | M1 |





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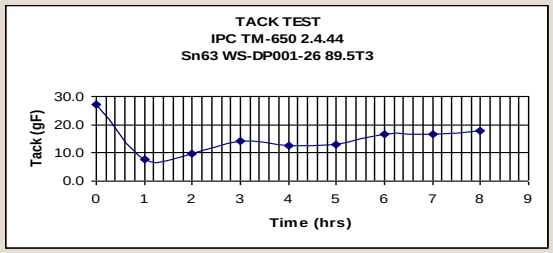
| Name | Test Method | Typical Results | Image |
|---|---|---|---|
| Qualitative Halides, Silver Chromate | J-STD-004 3.5.1.1 IPC-TM-650 2.3.33 | Halides Present |  |
| Qualitative Halides, Fluoride Spot | J-STD-004B 3.5.1.2 IPC-TM-650 2.3.35.1 | No Fluoride | |
| Surface Insulation Resistance | J-STD-004 3.2.4.5 IPC-TM-650 2.6.3.7 | PASS | Cleaned |
| Acid Value Determination | J-STD-004B 3.4.2.2 IPC-TM-650 2.3.13 | 55.2 mg KOH/g Flux Typical | |
| Viscosity | J-STD-004B 3.4.2.4 IPC-TM-650 2.4.34 | Print/Dispense Versions Available | |
| Visual | J-STD-004B 3.4.2.5 | Dark Brown | |
| Slump | J-STD-005A 3.6 IPC-TM-650 2.4.35 | PASS | |
| Solder Ball | J-STD-005A 3.7 IPC-TM-650 2.4.43 | PASS |  |
| Tack | J-STD-005A 3.8 IPC-TM-650 2.4.44 | 30.5 gf Typical |  |
| Wetting | J-STD-005A 3.9 IPC-TM-650 2.4.45 | PASS |  |

*In order to be rated ORL0, the solder paste has to pass SIR without cleaning. As WS488 is a water soluble paste chemistry that requires cleaning, it is rated ORM1 by IPC standards.





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# PROFILE SUPPLEMENT FOR LEAD-FREE ALLOYS

This information is provided as a reference guideline only. Your temperature profile will depend upon many factors including customer requirements, component characteristics and restrictions, oven characteristics, board layout, etc. Ultimately, quality requirements should define the profile in use, not adherence to these guidelines.

These reference guidelines follow the recommendations of the standards IPC-7530 for Temperature Profiling for Mass Soldering Processes, IPC-9502 PWB Assembly Soldering Process Guideline for Electronic Components, IPC/EIA J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies and IPC/JEDEC J-STD-020C Requirements for Small to Very Large Bodied Components.

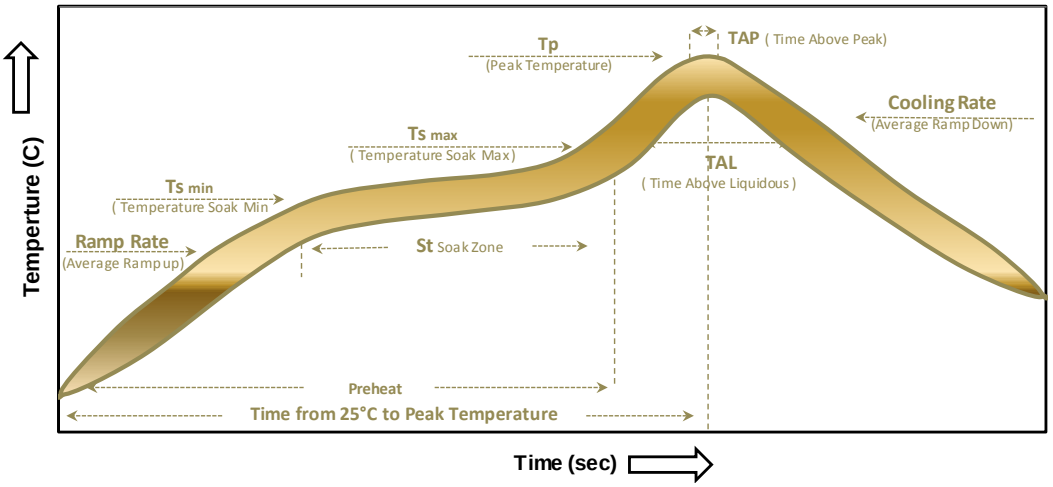
Ideally, temperature profile measurements are to be collected on a populated assembly with the reflow profile recorded for each product being processed. IPC-7050 provides guidelines for the construction of reflow profiling test vehicles and various techniques for reflow temperature profiling. It is common for the same profile settings to be used for multiple assemblies. It is recommended that profile data should be collected, analyzed and recorded for each assembly part number at the beginning of individual production runs for process verification and record keeping.

## REFLOW SOLDERING PROFILE DEVELOPMENT

The reflow temperature profile is defined by the relationship of temperature versus time during heating. There are two basic temperature profile types: Ramp-Soak-Spike (RSS) and Ramp-to-Spike (RTS). The RTS temperature profiles are suitable for use in most applications for enhanced solder performance. RSS temperature profiles are appropriate when the assembly has a large thermal mass or large ΔT.

The profile should be cross referenced with component manufacturer recommendations to ensure the maximum temperature limitations on all materials are not exceeded. It is advisable to verify the thermal sensitivity of components per the supplier specification or refer to IPC- 9502, before defining a process and reflow profile.

## RAMP–SOAK–SPIKE PROFILE (RSS)

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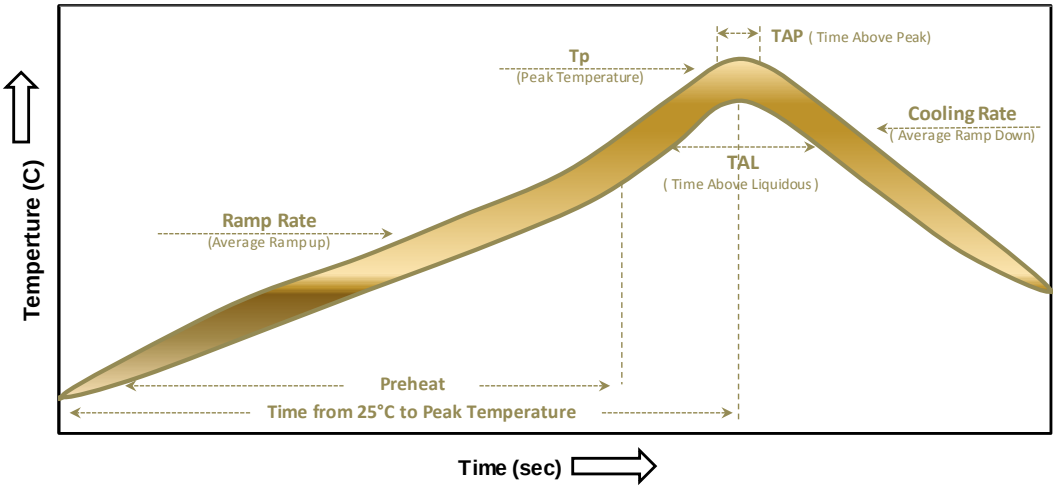
## RECOMMENDED PARAMETERS FOR RSS

| Profile Feature | General Profile IPC/JEDEC[1] | No Clean Flux (Recommended starting point)[2] | Water Soluble Flux (Recommended starting point)[3] |
|---|---|---|---|
| **Ramp Up Rate** | < 3 °C/sec. | 1 - 3 °C/sec. | 1.5 - 3 °C/sec. |
| **Soak Zone Ts min - Ts max** | 150°C - 200°C | 150°C - 200°C | 150°C - 180°C |
| **Soak time (Pt )** | < 180 sec. | 30-90 sec. | 20-40 sec. |
| **Time Above Liquidous (TAL)[4]** | 30-90 sec. | 30-90 sec. | 30-90 sec. |
| **Peak Temperature (Tp)** | 230 °C - 260 °C | 235 °C - 250 °C SAC alloys<br>245 °C - 260 °C SN100C | 235 °C - 250 °C SAC alloys<br>245 °C - 260 °C SN100C |
| **Cooling Rate** | < -6 °C/sec. | < - 4 °C/sec. | < - 4 °C/sec. |
| **Time From 25°C to Peak** | < 6 min | 3 - 4.5 min | 3 - 4 min |

## RAMP-TO-SPIKE PROFILE (RTS)




## RECOMMENDED PARAMETERS FOR RTS

| Profile Feature | General Profile IPC/JEDEC[1] | No Clean Flux (Recommended starting point)[2] | Water Soluble Flux (Recommended starting point)[3] |
|---|---|---|---|
| **Ramp Up Rate** | < 3 °C/sec. | 1 - 3 °C/sec. | 1.5 - 3 °C/sec. |
| **Time Above Liquidous (TAL)[4]** | 30-90 sec. | 30-90 sec. | 30-90 sec. |
| **Peak Temperature (Tp)** | 230 °C - 260 °C | 235 °C - 250 °C SAC alloys<br>245 °C - 260 °C SN100C | 235 °C - 250 °C SAC alloys<br>245 °C - 260 °C SN100C |
| **Cooling Rate** | < -6 °C/sec. | < - 4 °C/sec. | < - 4 °C/sec. |
| **Time From 25°C to Peak** | < 6 min | 3 - 4.5 min | 3 - 4 min |





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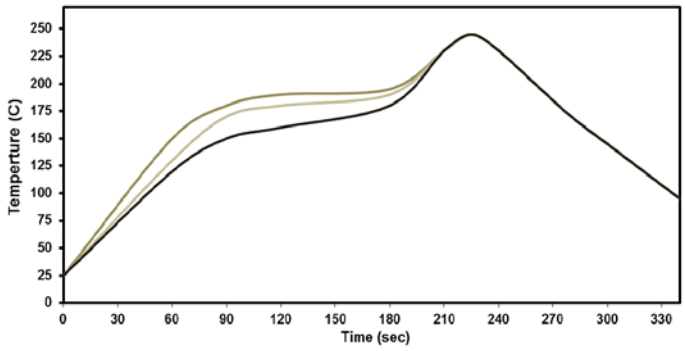
## SPECIAL PROFILES

### Wetting Improvement

Wetting issues, whether component or substrate may be improved through profiling. If the wetting issue is global, it can often be improved with proper profiling technique. If the wetting issue is component specific, it is likely a plating issue with the component/substrate. Profiling can be manipulated to improve wetting, but may affect other devices on the assembly. A general approach to enhance wetting is to shorten the profile to as little as three (3) minutes and to increase the peak temperature by 10-15°C.

### Void Reduction

Solder paste is approximately 50% flux by volume and not all of this flux can be evacuated from the solder joint during reflow. Profiling techniques can be used to reduce void formation with modest improvements. Other process variables may have more significant impact.

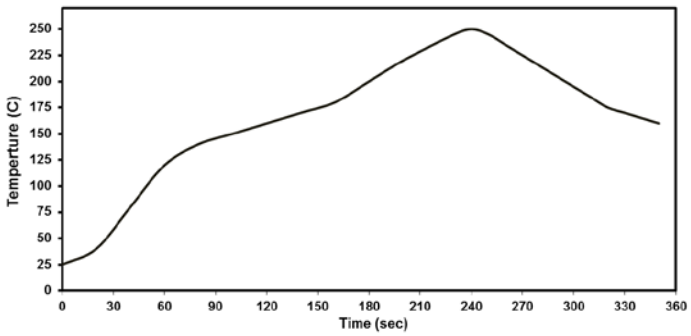



**Typical Void Reduction Profiles For No Clean Flux**

Ramp Rate to Soak: < 3 °C/sec. Typically 1-3°C/sec.
Soak Zone: 150-200°C for < 90 sec. Typically 30 sec.
Time from 25°C to Peak: Typically 3-4.5 minutes.
Time Above Liquidous: 30-90 sec.
Peak Temperature: 235-260°C
Typically 235-245°C. SAC alloys
Typically 245-255°C. SN100C
Cooling Rate: < - 4°C/sec.

### BGA Head-in-Pillow (HiP) Reduction

This profile will help reduce the effects of warpage of plastic BGA packages that leads to HiP defects and may require peak temperature in penultimate heating zone.




**Typical HiP Reduction Profile for No Clean Flux**

Time from 25°C to Peak: 4 - 4.5 minutes
Ramp Rate to Soak: 2-3°C/sec.
Soak Zone: 150-180°C
Soak Time 30-90 seconds.
Ramp Rate Soak to Peak: 1-1.5°C/sec. max.
Peak Temperature: 235-260°C
Typically 235-245°C. SAC alloys
Typically 245-255°C. SN100C
Time Above Liquidous: > 60 sec.
HiP Cooling Rate: Peak to 210°C, 1-1.5°C/sec. max.
Cool Down Rate After 210°C: < - 4°C/sec.





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## REFLOW TEMPERATURE PROFILE TROUBLESHOTTING

| | Possible Cause | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Issue** | Preheat time Is loo long | Preheat time Is Too short | Preheat Temperature too high | Preheat temperature too Low | Excessive Time Above Liquidus (TAL) | Insufficient Time Above Liquidus (TAL) | Peak Temp Too High | Peak Temp Too Low | Cooling Rate Too Fast | Cooling Rate Too Slow | Profile Too Long | Profile Too Short | Ramp Up To Fast | Time from 25˚C to Peak Temperature to lhort | Time from 25˚C to Peak Temperature to long |
| **Dark residue** | ✓ | | | | | | | ✓ | | | ✓ | | | | |
| **Brittle solder / Cold Solder joint** | | | | | | ✓ | | ✓ | | | ✓ | ✓ | | | |
| **Disturbed solder joint** | | | | | | | | | | ✓ | | | | | |
| **Component deformation/ damage** | | | | | | | ✓ | | ✓ | | | | ✓ | | |
| **Crazing of residue** | | | | | | | | | ✓ | | | | | | ✓ |
| **De-wetting** | ✓ | | ✓ | | ✓ | | ✓ | | | | | | | | ✓ |
| **Random solder balls** | | ✓ | | ✓ | | ✓ | | | | | ✓ | ✓ | | | |
| **Grainy solder joints** | ✓ | | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | | |
| **Excessive flux residue** | | ✓ | | | | ✓ | | ✓ | | | | ✓ | | | |
| **Flux spattering** | ✓ | | | | | | | | | | | | | | |
| **Malleable/ weak solder joint** | | | | | ✓ | | | ✓ | | ✓ | | | | | |
| **Poor or non-wetting** | ✓ | | ✓ | | | ✓ | | ✓ | | | ✓ | ✓ | | | ✓ |
| **Popcorning/ component damage** | ✓ | | | | | | | | | | | | | | |
| **Solder spattering** | ✓ | ✓ | | ✓ | | | | | | | | | ✓ | | |
| **Thermal shock/ component damage** | | | | | | | | | ✓ | | | | | | |
| **Tombstoning** | | ✓ | ✓ | ✓ | | | | | ✓ | | | | | | |
| **Voiding** | | ✓ | | ✓ | | ✓ | | ✓ | | | | | | | |
| **Wicking solder** | | ✓ | | | | | | ✓ | | | | | | | |
| **Solder beads** | ✓ | | | | | | | | | | | | | | |
| **Head in pillow Hip** | | | | | | | | ✓ | ✓ | | | | | ✓ | |

This defect information is specific to potential causes that are reflow profile related. Soldering defects can be caused by a myriad of other process/material variables. Please consult AIM Technical Support for targeted process and profiling assistance.





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## TERMS AND DEFINITIONS

**Alloy, Tin Silver Copper (Sn-Ag-Cu):** An alloy that is used as a lead-free solder consisting of tin, silver and copper as the main constituents.*

**Alloy, Tin Nickel Copper (Sn-Ni-Cu):** An alloy that is used as a lead-free solder consisting of tin and copper considered to be applicable for wave or reflow soldering.

**Allowable Temperature:** The temperature range that an electronic circuit or component can perform its intended functions.

**Component:** An individual part or combination of parts that, when together, perform a design function(s).*

**Cold Solder:** A solder connection that exhibits poor wetting and that is characterized by a grayish, porous appearance caused by insufficient application of heat during the soldering process.

**Disturbed Solder Joint:** A solder connection that is characterized by the appearance that there was motion between the metals being joined when the solder was solidifying.*

**De-wetting:** Retreating of solder from some or all parts of a substrate that initially was wetted.

**Flux:** A chemically and physically active compound that, when heated, promotes the wetting of a base metal surface by molten solder by removing minor surface oxidation and other surface films and by protecting the surfaces from re-oxidation during a soldering operation.*

**Flux Residue:** A flux-related contaminant that is present on or near the surface of a solder connection.*

**Head-in-Pillow (Hip):** Head-in-pillow (HiP), also known as ball-and-socket, is a solder joint defect where the solder paste deposit wets the pad, but does not fully coalesce with the BGA sphere. The resulting solder joint forms enough of a connection to have electrical continuity, but lacks mechanical strength. These components may fail with very little mechanical or thermal stress. This defect is not usually detected in functional testing leading to a field failure.

**Liquidus:** The temperature at which solder reaches its fully molten or liquid state.

**Non-wetting:** A surface that has contacted but rejected molten solder.

**Packages:** The container for a circuit component, or components that is used to protect its contents and to provide terminals for making connections to the rest of the circuit.*

**Peak/Spike Temperature:** Peak temperature is the maximum temperature recorded by the thermocouple for the monitored location.

**Popcorning:** Eruptions in an IC during reflow, normally the result of moisture absorption.

**Reflow Profile:** The time vs. temperature graph of a PCB as it is processed through a heat source.





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**Ramp Up:** The portion of the profile where the assembly is heated from ambient temperature at a predetermined rate. Controlling the ramp is necessary to prevent thermal component damage.

**Preheat / Soak Time:** The time is monitored to ensure temperature equilibrium across the assembly. This portion of the profile also allows time to drive off volatile ingredients within the solder paste and activate the paste's flux to remove oxides. Soak Time or Preheat time = tsmin to tsmax.

**Solder Balls:** Tiny spheres of solder usually located around a solder joint or randomly around the board.

**Solder Beads:** A solder ball positioned between the terminations of a discrete component, usually a resistor or capacitor, but can also be found on large and small transistors as well. It is often a function of paste volume as well as reflow profile.

**Time Above Liquidus:** This is the time in which the solder alloy is in a liquid phase. The assembly must spend enough time in this state to ensure all areas of the assembly are properly reflowed.

**Time Above Peak:** The time in which the component measured achieves the highest temperature.

**Ts Max:** Maximum temperature of soak.

**Ts Min:** Minimum temperature of soak.

**Tombstoning:** A soldering defect in which a component is pulled into a vertical or angular position leaving one side unsoldered.

**Wetting:** The formation of an intermetallic allowing the spread of molten solder over a base metal.

**Wicking Solder:** Wicking is a redistribution of solder caused by molten solder surface tension.

*Quoted from IPC-T-50.

[1]The general profile data are the parameters allowable by IPC/JEDEC, and are added only as a reference.
[2]This data guideline applies only to no clean flux. Special characteristics of flux will be described on TDS of the specific product.
[3]This data guideline applies only to water soluble flux. Special characteristics of flux will be described on TDS of the specific product.
[4]This temperature applies to most common lead-free alloys (i.e. SAC, SN100C). Special LF alloys should be described on TDS of the specific product.

This document applies to all AIM solder products that reference it on the TDS.





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