PRODUCT DATA SHEET

WF-9945

Wave Solder Flux

Introduction

WF-9945 is a halogen-free no-clean flux developed for wave soldering mixed-technology and through-hole electronics assemblies. **WF-9945** is formulated to provide excellent wetting and superior hole-fill under a wide variety of conditions. When compared to Indium Corporation's halogen-free WF-9955, **WF-9945** contains more rosin, which increases heat stability and widens the effective heat profiles, allowing for very high yield when wave soldering larger, thicker, and more complex circuit boards. The trade-off is slightly more visible residue and in some cases, changes required to electronic probe testing procedures. **WF-9945** is designed for use with tin-copper, tin-silver-copper, and tin-lead alloys.

Features

- **Halogen-free per J-STD-004B***
  To be halogen-free per J-STD-004B, the formula must contain less than 500ppm of any kind of halogen, ionic- or non-ionically-bonded chlorine, bromine, or fluorine. This is new to J-STD-004B since fluxes that conform to the original J-STD-004 or J-STD-004A may still contain halogens that only disassociate at soldering temperatures, but leave a residue that contains ionic halogen.

- **Light-colored, low-residue, and rosin-containing flux for better performance on large and thick circuit boards**
  Rosin, modified rosins, and resins contribute to enhanced heat stability for thick or difficult-to-solder boards and for the encapsulation of flux activators. However, in some cases, rosins and resins may interfere with electronic probe-testability.

- **Compatible with Hot Air Solder Leveled (HASL), Immersion Silver, Electroless Nickel Immersion Gold (ENIG), and Organically Solder Preserved (OSP) Copper surfaces.**

- **For use with all common lead-free and tin-lead alloys, including:**
  SAC305; SAC105; SAC0307; silver-free tin-copper plus additive alloys, such as Indium Corporation's Sn995; Sn96.5Ag3.5; Sn63Pb37; Sn60Pb40; and many others.

Physical Properties

As received, Indium Corporation's **WF-9945** flux is light amber in color. This amber color is a result of more than one-half of the 5.77% flux solids being composed of amber-colored rosin or rosin derivatives. The balance of the flux is an anhydrous alcohol and aliphatic hydrocarbon blend having a flash point of 54°F. This solvent blend ensures even distribution of flux solids both during storage and during spray flux deposition. The specific gravity of **WF-9945**—0.796 at 25°C—is measurably higher than that of pure isopropyl alcohol. However, in contrast to higher solids content fluxes, specific gravity is not the best method to quality control **WF-9945**. This is because flux solids content is relatively low and small amounts of water contamination can confuse specific gravity measurements. While in-process quality control of **WF-9945** is not generally required, the best method to ensure both solids content and activity level is by acid value titration. The **WF-9945** formula contains no ionic or nonionic halogenated compounds. The total halogen content, as shipped, is warranted not to exceed 50ppm.

Test	Result
Color	Amber
Specific Gravity @ 25°C (77°F) @ 15°C (60°F)	 0.796 0.802
Acid Value mgKOH/g flux mgKOH/g flux solids	 14.4 249.6
Solids Content	5.77%
Flash Point (°F TCC)	54
J-STD-004B Flux Type	ROL0

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Test Data

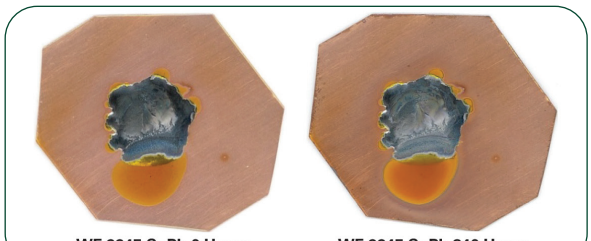
Copper Mirror

The J-STD-004B copper mirror test is performed per IPC-TM-650 method 2.3.32. To be classified as an "L" type flux, there should be no complete removal of the mirror surface. **WF-9945** exhibits no complete removal of the copper mirror and, therefore, is classified as an ROL0.

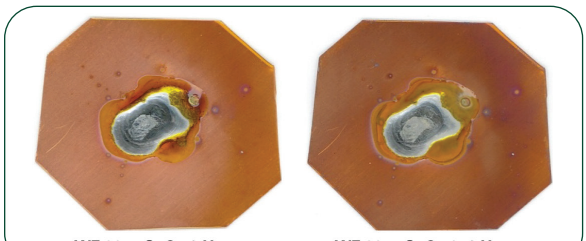
WF-9945 Standard Rosin

Copper Corrosion

Copper corrosion is tested per IPC-TM-650 method 2.6.15. This test gives an indication of any visible reactions that take place between the flux residue after soldering and copper surface finishes. In particular, green copper corrosion (formed as copper-chloride) should not be seen.



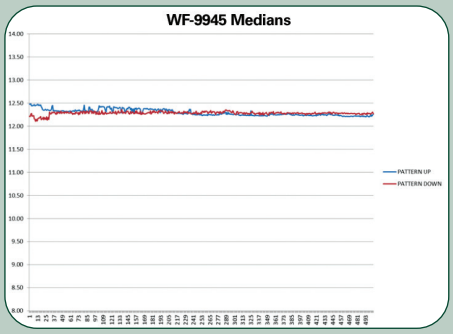
WF-9945 SnPb 0 Hours WF-9945 SnPb 240 Hours



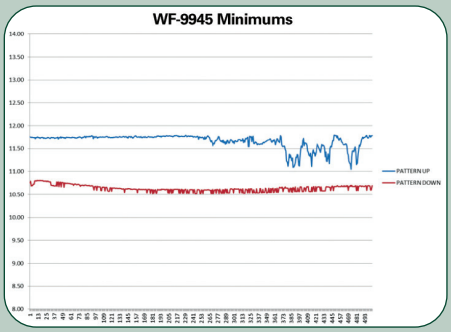
WF-9945 SnCu 0 Hours WF-9945 SnCu 240 Hours

Surface Insulation Resistance (SIR)

The Surface Insulation Resistance test is performed per IPC-TM-650 Method 2.6.3.7, using boards prepared per IPC-TM-650 method 2.6.3.3. All boards soldered with **WF-9945** pass the requirements of having exhibited no dendritic growth, no visible corrosion, and a minimum insulation resistance of 100 megohms (1 x 10^8). The values shown on the two adjacent graphs show the number of Ohms times ten to the power of the vertical axis. The IPC-TM-650 SIR is a 7-day test and gives a general idea of the effect of the flux residue on the electrical properties of the surface of the circuit board.



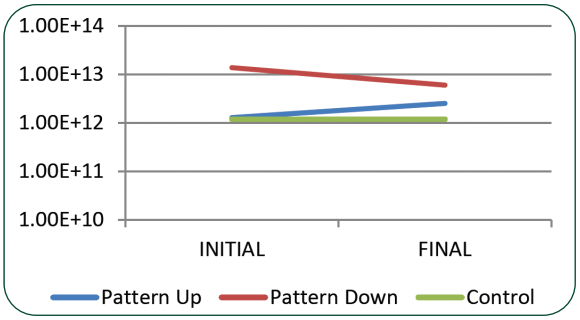
SIR Medians



SIR Minimums

Electromigration (ECM)

J-STD-004B Insulation Resistance Values		
	Average Values	
	Initial	Final
Pattern Up	1.30E+12	2.54E+12
Pattern Down	1.39E+13	6.04E+12
Control	1.19E+12	1.19E+12



The electromigration test is performed to IPC-TM-650 method 2.6.14.1 with boards prepared using IPC-TM-650 method 2.6.3.3. The test conditions for this test are 596 hours at 65°C ± 2°C and 88.5% ± 3.5% RH. To pass this test, there should be no visible corrosion and no dendritic growth that decreases line spacing by more than 20%. In addition, the insulation resistance should not drop more than one order of magnitude after the first 96-hour stabilization period when a bias voltage is applied.

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Performance and Process Data

Hole Fill

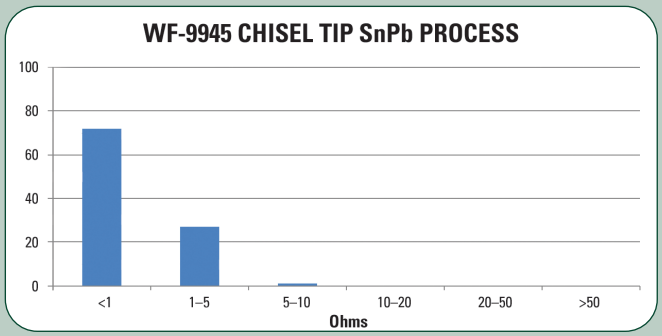
Indium Corporation uses several of its own tests, based on IPC workmanship standards, for determining hole fill. Depending on the design criteria for the flux, Indium Corporation uses holes of varying sizes and circuit board finishes. However, we always look for 100% hole fill, even though the IPC recognizes that a smaller degree of hole fill is acceptable for its workmanship standards. Testing is typically performed with both lead-free (Indium Corporation's Sn995 alloy) and tin-lead (Sn63Pb37) solders.

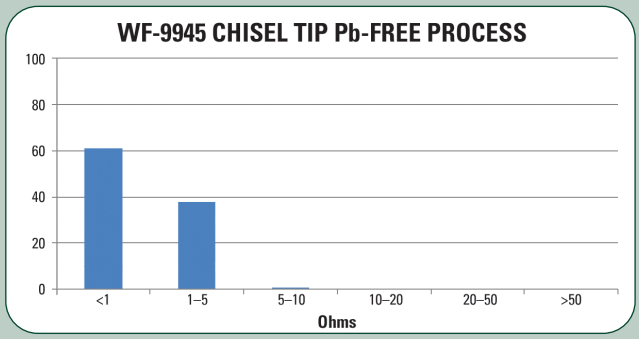
Soldering Performance*		
	Pb-Free	SnPb
100% PTH Fill Yield	98%+	99%+

**0.062" Indium Corporation test board 7 to 20mil diameter PTH*

Probe Testability

Indium Corporation tests its wave soldering fluxes using a test method based on IPC 9252, employing a 5.5-ounce chisel point test probe. This method measures the electrical resistance encountered by the test probe as a result of the presence of flux residue.





Process Recommendations

Indium Corporation tests all of its wave soldering fluxes on its own wave soldering machine prior to making them available to the market.

62mil-thick Circuit Board Process Recommendations

Flux Deposition Rate µg/in² solids	Preheat Temp		Preheat Time (sec)	Alloy	Contact Time (sec)	Pot Temp (°C)
	Top (°C)	Bottom (°C)				
750–1,500	85–120	85–125	50–75	Sn995	4–6	265–270
500–1,000	70–110	90–120	50–75	SnPb	1.5–2.0	250–260

Shelf Life

The shelf life for this product is **3 years** in an unopened container stored at temperatures from 5–32°C. Shelf life for an opened container will vary depending on storage conditions, including open time, temperature, and humidity. For longest shelf life of an opened container, replace cap to reduce alcohol evaporation and store in a cool, dry environment.

Residue Removal Recommendations

All of Indium Corporation's no-clean fluxes, including this formula, are designed to be electrically safe under normal consumer electronic and telecommunication operating conditions. Unless otherwise specified, electrically safe means that the post-soldering residues pass J-STD-004B SIR and ECM testing. However, it is understood that some customers desire to remove residues for cosmetic reasons, improved in-circuit testing, improved compatibility with specific conformal coatings, or where the operating parameters of the circuit board may be in extreme conditions for a prolonged period.

If the removal of no-clean flux residues is desired, most commercially available cleaning agents will be effective. Indium Corporation's Technical Support Engineers work closely with cleaning agent vendors and have confirmed flux residue removal capabilities from several vendors using their recommended products and parameters. It is unlikely that users of Indium Corporation's no-clean products will need to change their current residue removal materials and parameters from those currently used. However, when establishing a new process or desiring confirmation of process recommendations, please contact Indium Corporation's Technical Support staff for assistance.

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Indium Corporation Compatible Products

- **Solder Paste**: Indium8.9HF
- **Cored Wire**: CW-807
- **Flux Pen**: FP-500 (rosin-containing)

Indium Corporation's wave soldering fluxes have been designed to be fully compatible with our solder paste, cored wire, and rework flux, and are also expected to be compatible with many of our competitors' products. For example, **WF-9945 Wave Solder Flux** is not only compatible with Indium8.9HF Solder Paste, but also with our 5.8LS, 8.9 series, 92 series, and 10 series. Indium Corporation determines compatibility primarily by matching flux chemistry. However, a select number of wave, reflow, and rework product combinations have been thoroughly tested to ensure that the combined flux residues meet the electrical and reliability requirements of IPC J-STD-004B. Please contact Indium Corporation Technical Support if you are interested in knowing about these fully-tested combinations.

Health, Safety, Environmental, and Shipping

REACH

No substances of very high concern (SVHC) are used in this product.

Hazard Label

DOT Classification

Transport in accordance with applicable regulations and requirements. UN 1987, Alcohols, N.O.S., 3, PG II (isopropanol, mineral spirits) North America Emergency Guide Book—Guide #127

Additional Information

*J-STD-004B is the IPC Joint Industry Standard for classifying and testing soldering fluxes. It varies from the prior versions, J-STD-004 and J-STD-004A, in two very important ways. J-STD-004B uses a modified electromigration (ECM) test battery which is designed to better test the effects of the flux in high humidity conditions at normal operating temperatures and voltages. The environmental test is specifically designed to try to create dendritic growth and create failure in marginal flux formulas, unlike the prior version of J-STD-004 which used higher temperatures and voltages that did not grow dendrites as easily. Also, J-STD-004B halogen testing now reveals the total amount of halogen in a flux by first using an oxygen bomb to disassociate any halogen from the chemical compounds that they are bound to, and then collecting and quantifying them. Prior versions of J-STD-004 were unable to detect halogens that were present, but only disassociated at high temperatures (such as soldering temperature). As such, prior testing methods might give the user a false sense that no halogens are present in the flux, when in fact they are. Indium Corporation strongly supports the enhanced features of J-STD-004B because it better serves the users' need for information.

This product data sheet is provided for general information only. It is not intended, and shall not be construed, to warrant or guarantee the performance of the products described which are sold subject exclusively to written warranties and limitations thereon included in product packaging and invoices. All Indium Corporation's products and solutions are designed to be commercially available unless specifically stated otherwise.

All of Indium Corporation's solder paste and preform manufacturing facilities are IATF 16949:2016 certified.
Indium Corporation is an ISO 9001:2015 registered company.

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