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Solder plus Support

A New Twist on an Old Standard

Before rejecting a flux, be sure you understand the standard.

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J-STD-004 was updated about five years ago, but the comingling of designations from the old (A) and new (B) revisions in industry literature has created much confusion among users. What changed, what didn't, how does it affect flux selection criteria, and what does a user need to know? Here's a quick overview:

Flux designation has three components. The first two letters, RO, RE or OR, represent the basic chemical composition: rosin-based, resin-based or organic acid-based. Nothing has changed there. But the next component to flux designation, L, M or H, which describes the flux's activity level as low, medium or high, and the final component, 0 or 1, which indicates halide content, are affected by the new revision.

A flux's activity is determined by a number of tests. Most of these tests remain the same, but two important ones have changed. The most notable change is to the SIR testing, with updates to the test's environment, electrical bias and sampling frequency. The other major change is the elimination of the qualitative halide test; this can significantly affect the halide content portion of the designation for a large number of fluxes. Table 1 summarizes the changes.

What the PCB assembly engineer needs to know:

- **Don't dismiss L1 fluxes just because they have some halides.** Considering Revision B's closure of the spot test loophole, the old L0 flux could contain more halides than the new L1 flux. Keep in mind that the newer flux, which may be labeled L1, passed a far more stringent SIR test than the older one labeled L0.

- **Know the relationship between halides and halogens.** Halides are ionic compounds typically used as activators and often associated with corrosion. IPC standards address test methods and thresholds for halide content. Non-ionic halogenated compounds, or halogens for short, are sometimes used to improve the stability of fluxes and are the subject of environmental watch lists. European Environmental Standards (EN-14582) address test methods and thresholds for halogen content. A halide-free flux may not necessarily be halogen-free, but a halogen-free flux will also be halide-free.

- **Understand the subtle differences between rosin and resin.** The terms are often used interchangeably, but rosin is a naturally occurring substance, and resin is either a modified rosin or completely synthetic material. Rosins are plant products and are subject to more natural variation than resins; resins are commonly used in newer flux formulations due to their more consistent performance. When more than one rosin/resin are combined, the IPC classification is based on the larger constituent. Therefore, if the distinction between RO and RE is important to the user, they should inquire with the flux's manufacturer to better understand the exact details of the content and classification criteria.

- **Ask about the classification standard.** The revised standard has been in force for roughly five years. If a flux formulation is over five years old, it was likely classified under the previous system; if it is fewer than five years old, it was likely classified under the current system. Some fluxes are classified under both. If the technical data sheet does not specify whether the product was classified to J-STD-004A or J-STD-004B, just ask.

The expiration of the RoHS exemptions is driving most of the industry to Pb-free materials and processes. One of the key tools that significantly improves the joint formation capability of lead-free solders is … wait for it … *halides*. Yes, halides. Taking the more stringent SIR/electromigration requirements of J-STD-004B into account, the rejection of a flux product simply because the IPC classification is "1" and not "0" can handcuff an operation and adversely impact yields, productivity and solder joint quality.

All PCB assemblers share a similar goal: to make many good solder joints with flux characteristics that meet the mission profile of the assembly. Blindly adhering to a specification without regard to the implications is a classic case of the tail wagging the dog; summarily limiting assemblers' chemistry options based solely on nomenclature compromises soldering performance and, ultimately, the end-products' long-term reliability.

TABLE 1. Significant Differences Between J-STD-004A and J-STD-004B

TEST METHOD	PREVIOUS	CURRENT	IMPLICATIONS	COMMENTS
Surface insulation resistance (SIR)	85°C	40°C	**The new test is tougher:**	Lower temperature/higher humidity is challenging for VOC-free (water-based) fluxes. The extra moisture in the chamber causes the acids to ionize and give falsely low resistance readings.
	85% RH	90% RH	Lower temperature does not decompose fluxes as quickly.	
	48V Bias	10V Bias	Higher humidity causes flux to absorb more moisture and become more ionic.	
	7 days	7 days	Higher bias on previous tests could cause dendrites to grow and get obliterated before being detected.	
	Resistance measured on days 4 and 7	Resistance measured every 20 min	Lower bias on new test slows the self-destruction of the dendrites, and the more frequent monitoring makes dendritic growth easier to capture.	
	Min resistance = 100 MΩ	Min resistance = 100 MΩ		
Qualitative halide	Spot test for chlorides and bromides: A drop of flux is applied to chemically treated paper. If the paper's color doesn't change, the flux is considered halide-free and assigned a 0; no more halide testing is required.		**This test method had a hole in it:**	**Eliminated.** All fluxes now subjected to Quantitative Halide test. Qualitative halide has become optional.
	If the paper's color does change, it indicates that halides are present. The flux will be assigned a 1, and halide content must be quantified by ion chromatography (IC).		*Halide-free* is considered to be anything less than 500ppm 0.05% as measured by ion chromatography (IC).	
			The spot test was sensitive to about 3000ppm, or 0.3% chlorides or bromides. Fluxes with halides contents up to 0.3% could pass the spot test, never go to the quantitative halide test, and get legitimately labeled as halide-free under J-STD-004A.	
			Because J-STD-004B requires quantitative testing, many of the same fluxes that were designated L0 will now be considered L1 under the new system.	
Quantitative halide	Determine halide content by IC and express it as a percentage of the flux's solids content.	No change	**Reclassification is optional:**	Test method is more challenging for low-solids fluxes than high-solids ones. Because the halides are expressed as a percent of the solids content, low-solids fluxes are more vulnerable to higher readings due to trace amounts of halides that are part of other ingredients.
			The previous classification system allowed for some leeway in assigning the designation "halide-free." In addition to the inadequate detection limits of the spot test, number rounding practices could report halide content as just below the threshold where L0 becomes L1.	
			The J-STD-004B revision addresses the ambiguity of the earlier specification, but flux manufacturers are not obliged to reclassify materials already in the marketplace; therefore, some fluxes currently sold as L0 are actually L1 by current standards.	

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