

FLUX CORED WIRE SHELF LIFE STUDY

David Hillman
Rockwell Collins
Cedar Rapids, IA, USA
ddhillma@rockwellcollins.com

ABSTRACT

The use of cored wire solder for manual soldering operations is a basic tenet of the electronic industry soldering practices. The shelf life characteristic of any soldering process consumable is a key material attribute. The typical shelf life recommendation issued by a cored wire solder manufacturer is two years maximum. It is a rare event for most soldering operations to not consume a cored wire solder spool before reaching the two year shelf life recommendation. However, changes in production volumes, reduced product cycle times or variations in spare product production schedules can result in situations where a spool of cored wire solder is not consumed and exceeds the two year shelf life recommendation.

This paper documents an investigation demonstrating that a two year shelf life recommendation is unnecessarily conservative

Keywords: Cored wire solder, shelf life characteristics

BACKGROUND

The use of cored wire solder for manual soldering operations is a basic tenet of the electronic industry soldering practices. Rockwell Collins has qualified a variety of cored wire solder products for use in manual soldering processes. The Rockwell Collins internal cored wire solder specification lists the various qualified products and their functional requirements. One of the functional requirements is the shelf life for cored wire solder. The specification states:

“SHELF LIFE: THE SELLER WARRANTS THAT THE FLUX CORED WIRE PRODUCT’S SHELF LIFE SHALL BE NOT LESS THAN TWO (2) YEARS AFTER RECEIPT AT THE PROCURING ACTIVITY WHEN STORED UNOPENED AT 21 – 27°C AND 30 – 70% RELATIVE HUMIDITY. ALL PRODUCT DEFINED BY THIS DRAWING SHALL BE MARKED WITH UNLIMITED SHELF LIFE UPON RECEIPT. “

Process cycle times and production volumes typically result in the consumption of a spool of cored wire solder well before the two year shelf life recommended by the cored wire solder manufacturers. However, specialty solder alloys, low rate production products or spare product production volumes/schedules can cause the use life of a cored wire solder product to exceed the recommended two year time period. Rockwell Collins has conducted a variety of

internal investigations demonstrating that the solder manufacturer’s two year shelf life recommendation is unnecessarily conservative.

Rockwell Collins does not use the solder manufacturer’s solder wire shelf life recommendation for solder wire products used in the assembly of equipment. Rockwell Collins’ solder wire shelf life recommendation is contained in the Rockwell Collins cored wire solder specification, which allows for an unlimited shelf life:

“SHELF LIFE OF CORED WIRE: MANY OF ROCKWELL COLLIN’S SPECIFICATIONS FOR FLUX CORED WIRE DO NOT CONTAIN ANY SHELF LIFE REQUIREMENT. THE MANUFACTURER DOES WARRANT THE PRODUCT FOR A FIXED AMOUNT OF TIME; HOWEVER, THE FLUX IS SEALED WITHIN THE WIRE AND PRODUCTION EXPERIENCE HAS PROVEN CORED WIRE CAN BE USED SUCCESSFULLY LONG AFTER ITS PURCHASE. THE USER SHOULD BE AWARE THAT VERY VERY OLD CORED WIRE MAY NEED TO BE SUPPLEMENTED BY EXTERNALLY APPLIED FLUX.”

This labeling protocol has been used by Rockwell Collins, to the author’s knowledge, since 1988 with no issues or negative impact to product integrity.

The question of cored wire solder shelf life/labeling required re-addressing as part of a routine customer process audit in May 2009. Rockwell Collins initiated a validation task of the cored wire solder shelf life and labeling protocol contained in the internal cored wire specification.

OBJECTIVE

The objective of the investigation was to demonstrate that the cored wire specification shelf life and labeling protocols are valid.

PROCEDURES

Four solder wire products with ages from approximately 5 years to 20 years were subjected to the IPC-JSTD-004 Spread Test in accordance with IPC-TM-650, method 2.4.46, modified for cored wire. These four samples were selected as they represented a significant cored wire product shelf life time span and represented actual cored wire products used in product assembly operations. The IPC-TM-650 method 2.4.46 is typically used for the assessment

of solid wire products but Rockwell Collins also uses the method for cored wire solder testing. The length of cored wire solder used in the test is adjusted to meet solder volumes produced when using solid wire samples. The use of equivalent solder volumes allows the nonbiased application of the test method IPC-JSTD-004 Appendix B-7 Spread Test Guidance table. The four cored wire products selected for testing were:

Cored Wire Product	Product Age
Alpha Reliacore 15	Approximately 5 Years Old
Alpha Reliacore II	Approximately 5-10 Years Old
Gardner XM200	Approximately 10-15 Years Old
Alpha Energized	Approximately 20+ Years Old

Table 1. Cored Wire Test Samples

The four spool samples had been in stored in typical factory conditions of 21°C and 30-60% RH.

Figure 1 illustrates the four cored wire solder products selected for testing.



Figure 1. Cored Wire Solder Products Tested

TEST RESULTS

Figure 2 thru Figure 5 illustrate the four solder wire products with their spread test result. The flux core material should cause the solder wire to reflow in a uniform manner. The IPC-JSTD-004 Appendix B-7 Spread Test Guidance table suggests that the minimum spread area be 78.5 mm². All four of the tested solder wire products met this suggested minimum spread area. The spread test results demonstrate that the flux materials in the solder wire are performing their designated function of promoting good wetting of the metal surface.

DISCUSSION

Rockwell Collins has conducted numerous internal investigations demonstrating that the solder manufacturer’s shelf life recommendation is unnecessarily conservative. The investigation re-validated those past historical efforts. Solder wire used by Rockwell Collins and the electronics

industry consists of a solder alloy wire that contains a core(s) of flux material required for making metallurgically sound solder joints. The traditional solder alloy is Sn63, Sn62, or Sn60 in accordance with the requirements of IPC-JSTD-006 specification and the flux core is in accordance with the requirements of the IPC-JSTD-004 specification. The solder alloy encases/forms a metallic hermetic seal preventing degradation of the internal flux core. Basic diffusion principles dictate that a metallic hermetic seal will not permit the diffusion of either atmosphere or moisture that would cause degradation of the internal flux core material. The flux core/solder alloy interfaces quickly reach an equilibrium state in the contained, sealed volume. The use of metallic hermetic sealing (either solder seal or welded seal) has been the basis for 20 year use life of military electronic package fabrication and is an industry best practice. These same physical principles and constraints apply to solder wire. Additionally, if a flux core material

had degraded over time then surfaces being soldered would immediately display poor wetting attributes. A production operator would not be able to create good solder joints as the wetting angle/geometry criteria in the industry specifications such as IPC-JSTD-001/IPC-A-610 could not be achieved. The Rockwell Collins Solder Training program instructs all solder process operators on the expected wetting reactions, thus creating a secondary shelf life assessment protocol that ensures substandard cored wire solder products are not used.

CONCLUSION

The investigation results demonstrate that the cored wire solder infinite shelf life labeling protocol is valid and a cost effective methodology.

ACKNOWLEDGEMENTS

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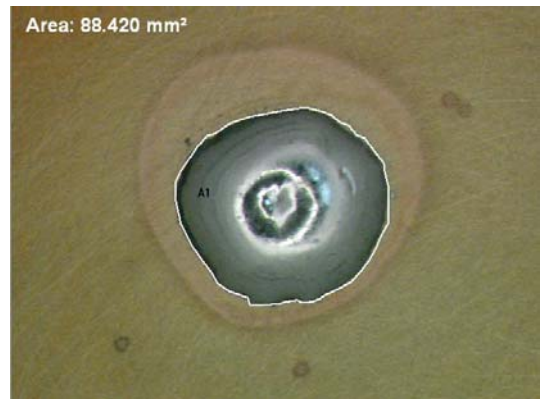


Figure 3: Gardner XM200: approximately 10-20 yrs old



Figure 2: Alpha Reliacore 15: approximately 5 yrs old

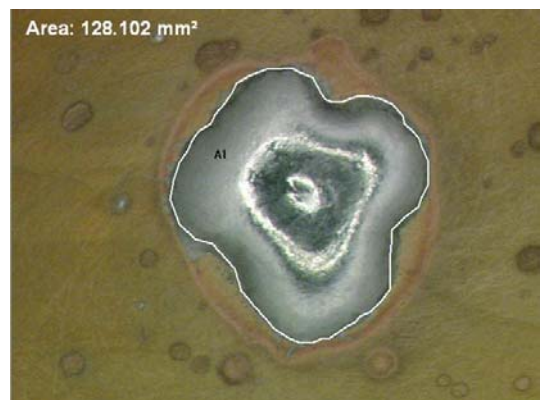


Figure 4: Alpha Reliacore II: approximately 5-10 yrs old

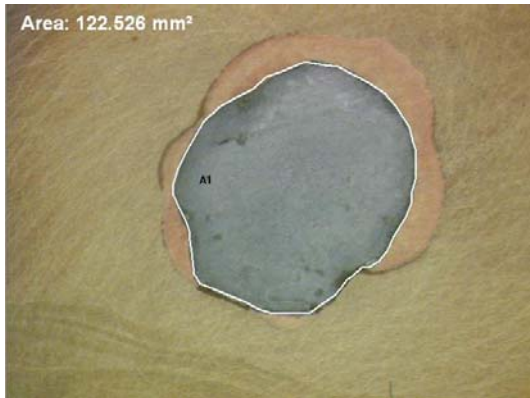


Figure 5: Alpha Energized Core: approximately 20 yrs old