

CPSA / IMA / Cleared
AS/1/95
WAC

**LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES**

SUBJECT: Thermoplastics and Back-Wire Push-In Terminals

DATE OF MEETING: January 11, 1995

PLACE OF MEETING: CPSC Headquarters

LOG ENTRY SOURCE: Erlinda M. Edwards, ESEE

COMMISSION ATTENDEES:

Bill King, ESEE
Ed Krawiec, ESEE
Linda Edwards, ESEE

NON-COMMISSION ATTENDEES:

Dave Dini, Underwriters Laboratories/Northbrook
Nick Wakeman, Product Safety Letter

SUMMARY OF MEETING:

Mr. King stated that the subjects to be discussed at this meeting were the applications of thermoplastics and the use of back-wire push-in terminals. The meeting was an outgrowth of the meeting Chairman Ann Brown had with Tom Castino, President of UL.

Mr. Krawiec explained that UL 746C, the standard for polymeric materials, is a benchmarking standard which allows comparison of one material to another under standardized conditions. The problem is that no UL standards take into account the abnormal conditions which are likely to occur in an end product. Several examples were given (panelboard enclosures, portable electric air heaters, switches, receptacles) in which failures resulting in temperatures far in excess of the temperature indices of materials used results in dimensional changes and, consequently, fails to provide mechanical support and allows migration of energized electrical parts. The plastic is also the fuel for the fire, right at the point where failure is occurring.

Mr. Krawiec added that the use of thermoplastics has grown, in part, because it is easily moldable. In addition, some grades of thermoplastic materials have demonstrated better performance in certain characteristics, e.g. arc-tracking, than some traditional thermoset materials. Consequently, product designers have taken advantage of those characteristics to improve the performance of the end product under normal operating conditions. However, by indiscriminately substituting thermoplastic materials for traditional materials (thermosets, ceramics and metals), a relatively low-level failure may now result in catastrophic failure. The fundamental problem is that thermoplastics lose their structural integrity at elevated temperatures.

✓

Mr. King explained that UL needs to look at their end-product standards--not UL 746C --and add a creative requirement to alert the product evaluator to look at the consequences of likely failure modes. In the course of evaluation, UL should not automatically accept, or grandfather in, every application for thermoplastics which has been used in the past. Perhaps a new type of overload performance test which would consider the consequences of likely failures could be developed.

Mr. Dini stated that UL is moving in the direction of Hazard-Based Safety Engineering (HBSE), and this problem seemed to fit in with that concept. HBSE is a long-range goal for UL. Mr. Dini added that UL has resources for plastics research to be used to improve evaluations of plastic materials.

Mr. Dini stated that UL makes sure that the plastics used in end-products are tested for normal temperature and environmental conditions. It is difficult to come up with tests to represent thermal runaway conditions. He asked if there were any particular product categories or key cases which could demonstrate the point. Mr. King suggested some product areas: temporary power taps, Christmas lights, receptacles, high-wattage appliances, panel boards, portable electric heaters, and switches. Mr. Krawiec added smoke detectors and generic components, such as plastic-bodied appliance switches, to the list.

Mr. King offered to draft proposed language which could be used in end-product standards to aid product evaluators in determining whether the use of thermoplastics is appropriate.

Regarding back-wire push-in terminations, Mr. Dini stated that, based on the Artech report and input from CPSC, UL had made several changes to standard UL 498, which became effective January 1, 1995. Mr. Dini said that he had been informed that some manufacturers had dropped listings of push-in terminated receptacles; those that have retained push-ins are the less expensive ones (for the do-it-yourselfers).

Mr. Krawiec briefly explained the history associated with push-in terminations. UL Bulletins 4 and 44, dated 4/2/71, deal with the extension of push-in terminations to copper-clad aluminum wire. The Bulletins lay out the test data which demonstrate that push-in terminations are poor performers. There were UL staff recommendations to withdraw listings for push-in terminations. Instead, UL extended the use of push-in terminations to copper-clad aluminum wire based on the premise that the data didn't look substantially worse than it did for copper.

In addition to inadequate electrical connections, Mr. Krawiec stated that UL's evaluation of receptacles with push-in terminations did not include an adequate evaluation of actual installation procedures or of the stresses placed on wires during installation. For example, pushing a receptacle into a junction box while holding the receptacle by the yoke results in potential separation of plastic parts and loss of ground integrity.

Mr. Krawiec stated further that the work Artech did was limited; Carl Fenstermaker (CPSC) continued some of that work at the CPSC laboratory. It was his conclusion that

push-in terminations should not be used; they are not adequate. Work performed by Dr. Jesse Aronstein over the course of nine years showed that 1) push-in terminations are not equivalent to wire-bind screw terminations, and 2) termination failures are time dependent; the load current is a factor but is not the major issue in determining if or when a push-in termination will fail.

Mr. Krawiec concluded by stating that this is not just a performance issue; this is a safety issue. Although many failures of these types of terminations may result in an open circuit, a significant percentage will experience increased resistances that will cause higher temperatures which may result in fire. The recent trend of substitution of thermoplastic for thermoset materials in wiring devices can only result in an increase in the number of failures and fires.