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REMOVING INSULATION FROM
ALUMINUM MAGNET WIRE

PDO 6984843, Topical Report

D. Hollar, Project Leader

Project Team:

J. Ensor

C. Camp

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**Kansas City
Division**

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Department 862**

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REMOVING INSULATION FROM ALUMINUM MAGNET WIRE

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May 1974

Prepared by D. Hollar, D/862, under PDO 6984843

Processes were investigated for removing polythermaleze insulation from a wire tape consisting of 90, AWG 33 solid aluminum wires. Commercial chemical, mechanical, and laser techniques were considered. Chemical agents containing methylene chloride were the most successful. Mechanical and laser methods produced less desirable results.

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THE BENDIX CORPORATION

KANSAS CITY DIVISION

KANSAS CITY, MISSOURI

A prime contractor for the
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Contract Number AT(29-1)-613 USAEC

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SUMMARY

Interest in using an AWG 33 solid aluminum conductor for a 90-wire woven tape established a requirement for terminating the small aluminum conductor. Termination consists of two basic tasks: removing insulation from the wire and joining the aluminum conductor to a copper conductor flex-circuit. This report covers insulation removal. A later report will deal with joining.

This phase of the project was to evaluate different insulation removal methods. The primary considerations were effectiveness of removal, damage to remaining insulation, damage to the basic wire, and convenience of stripping method. The stripping techniques investigated for use on 90-wire tapes were chemical, mechanical, and laser. A thorough investigation of these methods was required since the insulation has exceptional adhesion to the aluminum wire. The insulation is a polyester with an amide-imide overcoat.

Chemical processes proved to be the most successful. The chemicals containing methylene chloride provided acceptable samples with the Iso-Verre cream producing the best results. Acceptable stripping is defined as an even stripline across the wire tape and no insulation presence as indicated by microscopic examination.

Future work will involve joining techniques using stripped aluminum conductors.

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DISCUSSION

SCOPE AND PURPOSE

This project was begun to develop processes needed to prepare miniature terminations of aluminum wire to copper conductor flexcircuits. The techniques of stripping aluminum AWG 33, 90-wire tapes are covered in this report.

ACTIVITY

The aluminum-wire insulation consists of two layers of different materials. The inner layer is a cross-linked polyester that provides strength. The outer coating is a linear amide-imide. The linear polymer linkage provides flexibility. Layers of insulation are put onto the wire through several dip, wipe, and bake cycles.

Investigation of the commercially available insulation removal methods was required because of the exceptional adhesion of the insulation to the wire, and the fragile nature of the aluminum conductor.

Chemical Stripping

The chemical stripping agents evaluated used two basic systems of attack. The first group considered were stripping creams, which expand the insulation and break the bond with the wire. The action of the methylene chloride in the cream is analogous to the action of a sponge (insulation) in water (stripping cream). The cream also contains a mild organic acid which weakens the bond, allowing the cream and insulation to be wiped away.

Methylene chloride systems from three different vendors were evaluated:

- Lea Insulstrip Jel (Lea Manufacturing Company);
- Lonco Cream Wire Strip (London Chemical Company); and
- Iso-Verre (Societe de Fabrications Chimiques).

Lea and Lonco strippers were found to be of equivalent performance. However, the Lea stripper is more transparent than the Lonco thus allowing

better visibility of the stripping action through the cream coating. Both require immersion of the wire tape into the cream for a minimum of five minutes. During immersion a capillary attraction occurs. Upon removal, the wires are wiped with a paper towel. More thorough removal of insulation is achieved by brushing with a fiberglass brush. The strip line across the wire tape was uneven and a degradation of insulation occurred above the strip. The wires are finally solvent-cleaned in trichloroethylene.

The Iso-Verre cream was evaluated similarly. The wires were again immersed, but were removed immediately after reaching the desired strip length. After removal they are allowed to set for 15 seconds before wiping. Capillary attraction is reduced since the Iso-Verre cream is thicker. Period of exposure is also reduced, eliminating potential capillary attraction hazards. After stripping the residues dry to a water soluble white powder. Figure 1 is an example of the Iso-Verre stripped wire tape.

Figure 1. Aluminum Wire Tape, Sample on
Right Stripped by Iso-Verre Cream

The second group of chemical agents works by a combination of high temperature and alkaline salt. At approximately 700°F (371°C), the hydroxide ions from the salt attack and disintegrate the insulation in the pot.

Two hot alkaline salts, Rush Salts (alkaline salt unknown) and Kolene Salts (sodium hydroxide), were evaluated for stripping wire tapes.

In each case the bath is heated to vendor-recommended temperature of 700°F (371°C). The tape is then dipped into the bath for 6 seconds. A foaming action occurs at the bath surface until stripping is complete. After removal, the tape is immersed in water at room temperature, then into a five percent nitric acid solution to neutralize the residual salt and finally into water at room temperature again. Both nylon weaving and insulation are degraded for up to 1 inch (25.4 mm) above the desired strip line. Technique improvement reduced this area to approximately 0.25 inch (6.35 mm), but stripping was less complete.

The operation of both chemical systems requires strict safety precautions. The chemicals involved cause severe irritation to skin. Exposure of the salt bath to moisture causes violent reactions. Operators would require long sleeves, gloves, face shields, and a see-through protective material between themselves and the pot.

Mechanical Stripping

The mechanical stripping process for polythermaleze insulated aluminum wires consists primarily of fiberglass brushing. Samples of the aluminum 90-wire tape were sent to Carpenter Manufacturing Company, a vendor for fiberglass buff-stripping equipment. Their recommended process uses a rotating twin-cone device. The cones are aligned with the faces parallel and operate in opposing directions of rotation. Insulation is removed by abrasion between the two cones. Five to six wires are stripped at a time. The resulting strip is irregular and some wire damage occurs. Areas of insulation remained on the wires.

Laser Stripping

Laser removal of insulation on copper 90-wire tapes has proven successful. However, efforts directed toward aluminum tapes have been unsuccessful. The tolerance between stripping the wire and cutting the wire seems to be highly sensitive for aluminum. Success has been limited by frequent destruction of wires. Factors such as the small difference between the melting temperature of aluminum and charring temperature of the insulation result in a narrow tolerance process. Insulation removal has also been less thorough than with other methods.

ACCOMPLISHMENTS

Of all the stripping methods and materials investigated, chemical strippers of the methylene chloride system are the most successful. They provide a repeatable insulation removal method. The optimum stripping process was obtained by using the Iso-Verre cream. An acceptable alternate to Iso-Verre is the Lea Insulstrip Jel. Lea is preferred over the Lonco since it allows better visibility of the stripping action..

Alkaline salts, mechanical buffing, and laser stripping of aluminum all are unreliable. The alkaline salts are too hazardous to be considered as a prime alternative.

FUTURE WORK

Future work will involve joining techniques for attaching the aluminum wire to a copper conductor flexcircuit. Several low temperature soft soldering methods will be evaluated.