BDX-613-2037 (Rev.)

HIGH-DENSITY BRAID CABLE SHIELDS

By E. Belarde

Published December 1978

Final Report

Prepared for the United States Department of Energy
Under Contract Number DE-AC04-76-DP00613.

Bendix Kansas City Division

DISCLAIMER

Printed in the United States of America

Available From the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

Price: Microfiche $3.00
Paper Copy $4.00

BDX-613-2037 (Rev.)
Distribution Category UC-25

HIGH-DENSITY BRAID CABLE SHIELDS

By E. Belarde

Published December 1978

Final Report
E. Belarde, Project Leader

Project Team:
G. S. Darner
H. J. Edwards
E. R. Friebe
J. F. Galbraith

Communications Services

Bendix Kansas City Division

HIGH-DENSITY BRAID CABLE SHIELDS

BDX-613-2037 (Rev.), Final Report, Published December 1978

Prepared by E. Belarde

Development and improvement of electromagnetic radiation (EMR) shielding was undertaken. The study included cable braiding equipment, induction soldering, shield effectiveness and quality testing, and nondestructive defect locating equipment.

WPC-myw

The Bendix Corporation
Kansas City Division
P. O. Box 1159
Kansas City, Missouri 64141

A prime contractor with the United States Department of Energy under Contract Number DE-AC04-76-DP00613

CONTENTS

SUMMARY

This project was directed toward advancing the state of the art in electromagnetic radiation (EMR) shielding. The study involved development of braiding equipment that produces optimum cable shielding. Tests were developed to determine the effectiveness of various types of shields (single braid, double braid, bellow tubing or sandwich conductors) as well as the mechanical properties of such shields. A nondestructive technique was developed that electrically pinpoints defects in cable shields. In addition, induction soldering equipment and processing were developed to create consistently high quality connector-to-EMR hardware solder joints.

DISCUSSION

SCOPE AND PURPOSE

The purpose of this project was twofold.

- The first goal was to improve or develop Bendix Kansas City capabilities to produce electromagnetic radiation (EMR) shielding for multiwire, coaxial, and flex circuit cables.

- The second goal was to investigate and resolve EMR shield problems as they occurred during development of cables requested by Sandia Laboratories, Albuquerque, NM.

The work involved developing advanced braiding techniques, better fabrication methods for shield terminators, and techniques for measuring shield effectiveness.

ACTIVITY

Initial efforts to provide a high-density wire braid shield for coaxial and multiwire cables included development of processes to direct wire braid on cable assemblies, to electrically terminate the braid to connectors, and to seal braided assemblies against high-altitude failure. Modifications were added to the standard braiding machine and to the winding equipment to control variations in braid density and to reduce wire-crossover defects.[1] These modifications were evaluated[2] and refined to include a reliable technique for back-braiding.

Braid breakage caused by cable flexing and twisting, as seen by pullout cables, was evaluated. Because fatigue failure normally occurs close to the EMR hardware-braid terminators, different methods of braid terminations were investigated.[3] Although the shielding life can be increased when the braid is impregnated with cellulose nitrate,[4] it was found that the braid will break where it is flexed or twisted.

A study directed toward developing induction soldering for use on EMR hardware was conducted. This investigation measured the temperature difference across the seal between the connector insert and EMR shell end[2,4] and examined the extent of heat damage. An induction heating coil was developed which makes a consistantly air tight solder joint and minimizes heat transfer to the connector seal.[4]

A shielded-enclosure leak-detection system, called a "sniffer", was modified and successfully used to pinpoint and measure defects in braided cable shields.[5]

A test designed to measure EMR leakage of cable shielding at different frequencies was used to evaluate the shielding effectiveness of single braid, double braid, brass flexible bellow tubing, and steel flexible bellow tubing. In addition, the effectiveness of different flat cable shielding configurations against electromagnetic radiation and interference was studied.[6]

An electrically nondestructive technique for evaluating the quality of solder joints was found.[4]

ACCOMPLISHMENTS

The quality of cables for contemporary and subsequent programs has increased as a result of incorporating the following accomplishments.

- The ability to back-braid shields over 203.2 mm long with minimum effort was developed.
- Guidelines for fabricating flex circuit with optimum shielding capabilities were developed.
- An increase of approximately two to four times normal fatigue life was gained with one group of test cables impregnated with cellulose nitrate.
- A superior induction soldering coil that produces quality solder joints with no adverse side effects was developed.
- A nondestructive technique for pinpointing braid defects was developed.
- An electrically nondestructive technique for testing the quality of solder joints was developed.
- Equipment to apply braid for the most effective shielding was developed.
- Materials were tested for optimum capabilities of shielding multiwire and coaxial cables.
- The life expectancy of various sizes of braided shields versus bending and twisting was plotted.

REFERENCES

[1]J. F. Galbraith, *High-Density Shields*, FY72-1. Bendix Kansas City: BDX-613-543 (Rev.), February, 1972 (Available from NTIS).

[2]H. J. Edwards, *High-Density Braid Cable Shields*, FY72-4. Bendix Kansas City: BDX-613-776 (Rev.), March, 1973 (Available from NTIS).

[3]H. J. Edwards, *Fatigue Failure in Braided Electromagnetic-Radiation Shielding* (Topical Report). Bendix Kansas City: BDX-613-1192 (Rev.), February, 1975 (Available from NTIS).

[4]E. R. Friebe, *Induction Soldering Evaluation*, FY75-2. Bendix Kansas City: BDX-613-1453 (Rev.), August, 1976 (Available from NTIS).

[5]E. Belarde, *Defect Detection in High-Density Braided Shields* (Topical Report). Bendix Kansas City: BDX-613-1122 (Rev.), October, 1974 (Available from NTIS).

[6]G. S. Darner, *Shielding Effectiveness of Single Conductor Flat Shielded Cables*, FY76-A. Bendix Kansas City: BDX-613-1685 (Rev.), September, 1976 (Available from NTIS).

DISTRIBUTION

	Copy
R. Bulcock, DOE-KCAO	1
V. C. Vespe, DOE-ALO	2
J. A. Freed, LASL	3
S. J. Buginas, LLL	4
H. M. Brinkmeier, Monsanto	5
G. H. Donaldson, SLA	6
J. E. Long, D/531, 1A46	7
H. T. Barnes, D/554, BD50	8-9
L. Stratton, D/554, 2C44	10-12
C. R. Beary, Sr., D/755, 1C43	13
R. P. Frohmberg, D/800, 2A39	14
D. R. Lemon, D/846, MB40	15
G. A. Yocum, D/846, MB40	16
R. E. Kessler, D/865, 2C40	17

BDX-613-2037 (Rev.)

HIGH-DENSITY BRAID CABLE SHIELDS, E. Belarde, Final, December 1978.

Development and improvement of electromagnetic radiation (EMR) shielding was undertaken. The study included cable braiding equipment, induction soldering, shield effectiveness and quality testing, and nondestructive defect locating equipment.

ELECTRICAL: Cable Shields

HIGH-DENSITY BRAID CABLE SHIELDS, E. Belarde, Final, BDX-613-2037 (Rev.), December 1978.

Development and improvement of electromagnetic radiation (EMR) shielding was undertaken. The study included cable braiding equipment, induction soldering, shield effectiveness and quality testing, and nondestructive defect locating equipment.

HIGH-DENSITY BRAID CABLE SHIELDS, E. Belarde, Final, BDX-613-2037 (Rev.), December 1978.

Development and improvement of electromagnetic radiation (EMR) shielding was undertaken. The study included cable braiding equipment, induction soldering, shield effectiveness and quality testing, and nondestructive defect locating equipment.