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# TEMPERATURE RISE OF FLAT CONDUCTOR CABLE INSTALLED UNDER CARPET



James D. Hankins
Electronics and Control Laboratory

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This report contains the method, test data, and results of temperature rise tests on flat conductor cable installed under carpet and powered at up to twice rated loads.

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# TEMPERATURE RISE OF FLAT CONDUCTOR CABLE INSTALLED UNDER CARPET

## INTRODUCTION

Flat conductor cable (FCC), as a spinoff of aerospace developed technology, is highly desirable for use as residential, commercial, and industrial electrical wiring because of low installation costs. The shape of the FCC is one of the factors contributing to low installation costs; FCC is thin and for most practical purposes has only two dimensions, width and length. This thinness allows FCC to be attractively installed using techniques and in a manner not practical with conventional round wires; e.g., under carpet, under tile, behind paneling, under wallpaper, and surfaced-mounted on walls and ceilings. FCC is embryonic as a wiring system and, consequently, is not adequately covered by current electrical codes and standards.

## PURPOSE AND TEST SETUP

Tests were conducted to determine the temperature rise resulting from the electrical load of three-conductor, AWG No. 12 FCC installed under carpet on wood and on asphalt tiled, concrete floors.

The cable tested was 5.08 cm (2 in.) wide by 0.76 mm (0.030 in.) thick, with three copper conductors, 0.31 mm by 10 mm (0.012 in. by 0.400 in.), laminated between 0.23-mm (0.009-in.) films of Mylar-vinyl insulation. The conditions were simulated by installing cable, shield [0.15 m by 1.8 m (6 in. by 6 ft)], 0.48-cm (0.1875-in.) sponge carpet padding [0.6 m by 1.8 m (2 ft by 6 ft)], and short pile carpet [0.6 m by 1.8 m (2 ft by 6 ft)] on 1.9-cm (0.75-in.) plywood and tiled concrete as shown in Figure 1. The center conductor was not powered during the test. Thermocouples were placed above and below one of the loaded conductors to measure the shield/padding interface temperature and the cable/floor interface temperature. The cable was electrically connected as shown in Figure 2.

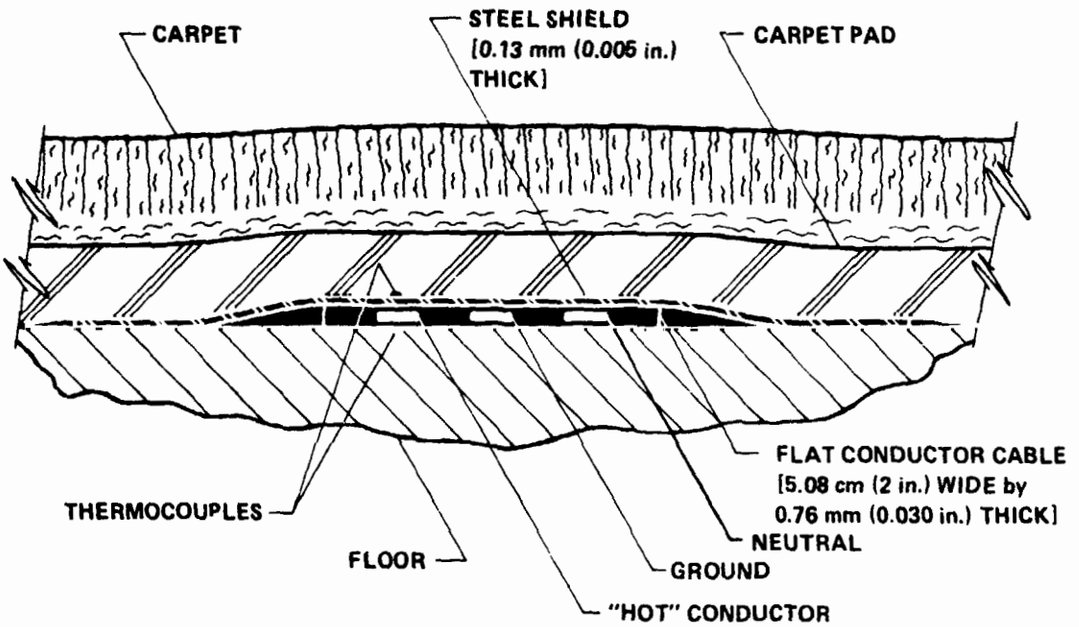


Figure 1. Cross section of FCC installed under carpet.

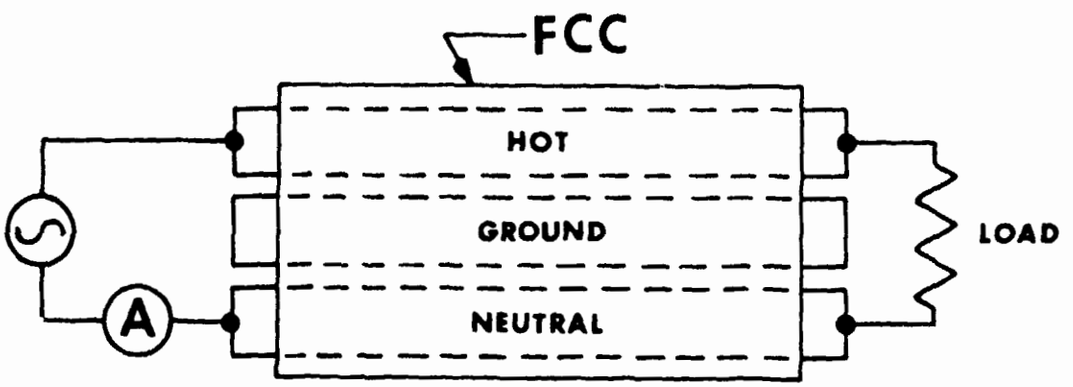


Figure 2. Electrical test setup.

# TEST RESULTS AND CONCLUSIONS

As expected, there were no temperature rise problems with the FCC even at over twice the rated load of the cable. Previous testing* of aerospace FCC has shown that single layers of flat conductors in air can be rated at 150 percent of that of equally sized round wires. This advantage is because of the high ratio of surface area to volume of FCC.

Table 1 and Figure 3 show the test data and curves. The temperature of the carpet surface was not measured, but even at the higher loads it was barely warm to the touch. It is noted that the asphalt tile acted as a thermal barrier and that cable installations on "bare concrete" would have lower temperature rises for respective current levels.

The test results show that the temperature rise of FCC installed under carpet presents no problem. In all cases, the carpet was pleasant to touch and materials were not degraded.

TABLE 1. FCC[a] TEMPERATURE DATA FOR INSTALLATION UNDER CARPET

| LOAD (Amps) | $T_1$ (°C) | $T_2$ (°C) | $T_3$ (°C) | $T_4$ (°C) | $T_5$ (°C) |
|---|---|---|---|---|---|
| 15 | 1.11 | 0.56 | 3.33 | 2.22 | 21.11 |
| 20 | 2.78 | 2.22 | 7.22 | 5.00 | 21.11 |
| 30 | 6.11 | 5.56 | 16.67 | 12.22 | 21.11 |
| 40 | 11.11 | 10.00 | 33.33 | 22.78 | 21.11 |
| 45 | 15.56 | 14.44 | 44.44 | 33.33 | 21.11 |

a. Three copper conductors, AWG No. 12 equivalent, Mylar-vinyl insulation.

NOTES:
1. $T_1$ is cable/floor interface temperature on tile floor.
2. $T_2$ is shield/padding interface temperature on tile floor.
3. $T_3$ is cable/floor interface temperature on wood floor.
4. $T_4$ is shield/padding interface temperature on wood floor.
5. $T_5$ is room temperature.
6. See Figure 3 for plotted curves.

*Documented in NASA TM X-64767, The Load-Carrying and Thermal Characteristics of Flat Conductor Cable, August 1973.

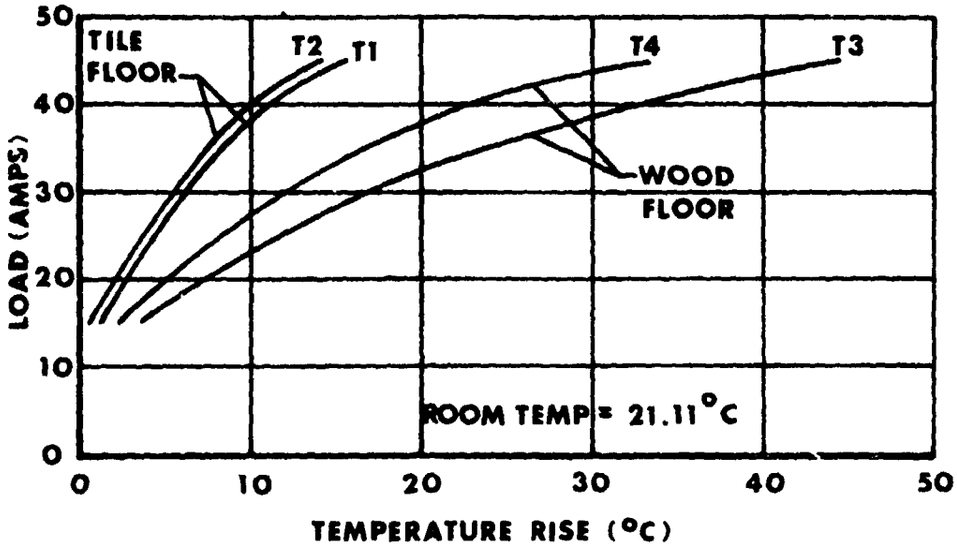


Figure 3. Temperature rise versus load of AWG No. 12 (copper) FCC installed under carpet.

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ED-533, A High Voltage Tester for Flat Conductor Cable Insulating Film.

ED-536, A Survey of Ground-Fault Circuit Interrupters for Use with Residential Wiring Systems.

ED-537, An Assembly Tool for Terminating Flat Conductor Cable to a Plug.

ED-539, Contact Resistance in the MSFC Individually Sealed Contact Connector for Flat Conductor Cable.

# APPROVAL

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By James D. Hankins

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

W. J. KRIEDER
Chief, Electronics Parts Development Branch

J. C. Taylor
Chief, Electronics Development Division

F. B. MOORE
Director, Electronics and Control Laboratory



MSFC—RSA, Ala