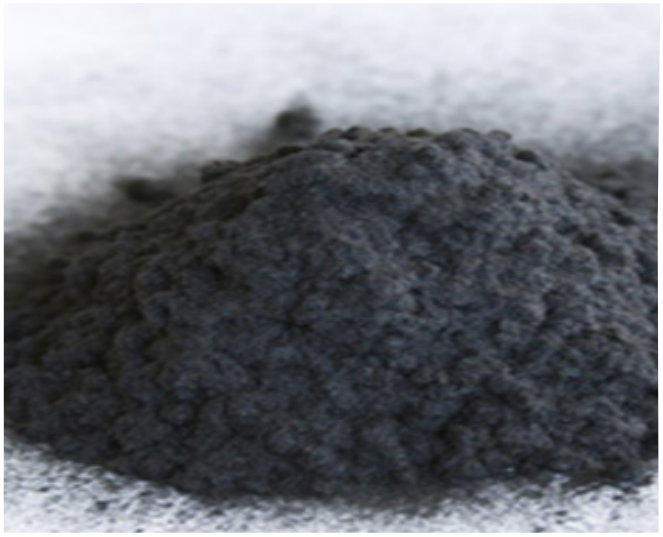
Electrical Conductivity Assessment of CFRTP Dust

Source: Understanding the Electrical Behavior and Safety Implications of Carbon Fiber Reinforced Thermoplastic Dust

Source: **Zoltek CFRP Dust Electrical Conductivity Study, July 2026**



Why This Study Was Conducted

Carbon Fiber Reinforced Thermoplastic (CFRTP) materials are increasingly used in manufacturing due to their lightweight strength and performance advantages. During machining and processing, dust is generated, raising questions about whether accumulated dust could create conductive pathways and pose electrical risks.

The study was designed to:

- *Evaluate the electrical resistance of CFRTP dust.*
- *Determine whether dust can form continuous conductive networks.*
- *Understand the influence of dust thickness, mass, and carbon fiber loading levels.*
- *Assess the potential risk of dust accumulation in manufacturing environments.*

Testing Methodology

Testing methods were adapted from recognized standards:

- ASTM D257 (Electrical Resistivity)
- ASTM D6054-97 (Sample Conditioning)

Samples were conditioned under controlled temperature and humidity before electrical resistance measurements were performed using a compressed dust test cell. Conductive behavior was defined as the formation of a continuous electrical path through the dust layer.

Key Materials Evaluated

CFRTP dust collected from compounds containing:

- 10% carbon fiber
- 12% carbon fiber
- 15% carbon fiber
- 25% carbon fiber
- 30% carbon fiber

Dust layers ranging from approximately 1 mm to 5 mm thickness were tested

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Results: CFRTP Dust Shows Predominantly Insulating Behavior

Dust samples were tested at different thickness levels to determine whether conductivity increased as dust accumulated.

- Approximately 75% of 1 mm samples behaved as resistive materials.
- 100% of samples at 2 mm and 5 mm thicknesses were resistive.
- Average measurable resistance at 1 mm thickness was approximately 13 MΩ.
- No stable conductive pathways were observed.
- Trial 2: Carbon Fiber Loading Verification

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Carbon Fiber Content	Average Resistance*	High-Resistance Readings
By weight	as per ASTM D257 in MΩ	in %
10%	N/A	100%
12%	N/A	100%
15%	2.69 MΩ	66.70%
25%	1.70 MΩ	66.70%
30%	N/A	100%

**Only non-open-loop readings included in averages.*

Interpretation

Changing carbon fiber loading levels did not produce a meaningful increase in conductivity. Most measurements remained highly resistive, indicating that CFRTP dust does not naturally create continuous conductive networks.

Comparison with Milled Carbon Fiber & Final Conclusions

To better understand the conductivity behavior, CFRTP dust was compared with milled carbon fiber.

Material	Average Resistance
CFRTP Dust	Mega-ohm range
Milled Fiber	0.25-0.38 Ω

Milled carbon fiber consistently produced conductive pathways and showed no resistive behavior during testing.

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Major Findings

✅ No stable conductive pathways were formed by dried CFRTP dust.
✅ Low-resistance readings occurred only occasionally and primarily at very short path lengths (~1 mm).
✅ Carbon fiber loading percentage had minimal effect on electrical behavior.
✅ Most CFRTP dust samples behaved as insulating materials under the tested conditions.
✅ Milled carbon fiber exhibited dramatically higher conductivity than CFRTP dust.

Safety Implications
Based on the testing performed:

Dried CFRTP dust presents a very low likelihood of forming sustained conductive paths.
Dust accumulation alone is unlikely to create significant electrical conduction hazards.
Manufacturing environments should continue standard housekeeping and dust management practices, but the evaluated CFRTP dust did not demonstrate consistent conductive behavior under the tested conditions.

Executive Summary

The study demonstrates that dried CFRTP dust behaves predominantly as an insulating material rather than a conductive one. Across multiple carbon fiber loading levels and dust thicknesses, stable conductive pathways were not observed. Compared with milled carbon fiber, CFRTP dust exhibited vastly higher electrical resistance, supporting the conclusion that accumulated CFRTP dust is unlikely to pose significant conductivity-related risks in normal manufacturing environments.

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