# RESISTIVITY MEASUREMENT ON 3D PRINTED SAMPLES

*Plasty Mladeč (Filament PM)*

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# 1. Introduction

A resistivity measurement was agreed between Plasty Mladeč | Filament PM (PM) and ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO branch (PIB). The measurement included measuring of delivered 3D printed specimens from ESD PETG material. Delivered specimens were printed with the same printing settings. The only difference among samples was infill ratio. These arrangements were printed to study the external shell quality and infill influence on resistivity.

# 2. Material description

PIB has received 6 types of specimens printed at different infill ratios. The samples were printed from the ESD PETG filament batch 73 / 02.12.2025 / L7 / 1. Samples were tagged as:

- 100% infill,
- 80% infill,
- 60% infill,
- 40% infill,
- 20% infill,
- 0% infill.

# 3. Arranged analysis and procedures

Specimens were analyzed according to ČSN EN 61340-2-3: Elektrostatika, which is heavily relating to ČSN EN ISO 3915: Plasty - měření odporu vodivých plastů. The specimens were obtained via FDM type printer (Bambu Lab P1S). To ensure the exact reproducibility of the external shell, following parameters were set during the printing process: nozzle temperature 290 °C; heatbed temperature 85 °C; default extrusion width 0.4 mm. The entire specimen consisted of a uniform 0.8 mm thick external shell (walls, top and bottom). Specifically, dimensions were 90 × 10 × 3 mm. Each sample consisted of 5 specimens. Fischer-Elektronik Milli-TO3 ohmmeter was used together with four-pole electrode 4P-1 to measure volume resistivity of delivered samples. The measurement required voltage of 0.01 mV and total measurement time was 60 s to get the final average value for each specimen. Sample conditioning and measurement was performed at 23 °C, 25% RH for 48 h.

A brief test illustration is visible in the *Figure 1*. All summarized results can be found in another chapter in *Table 1*.



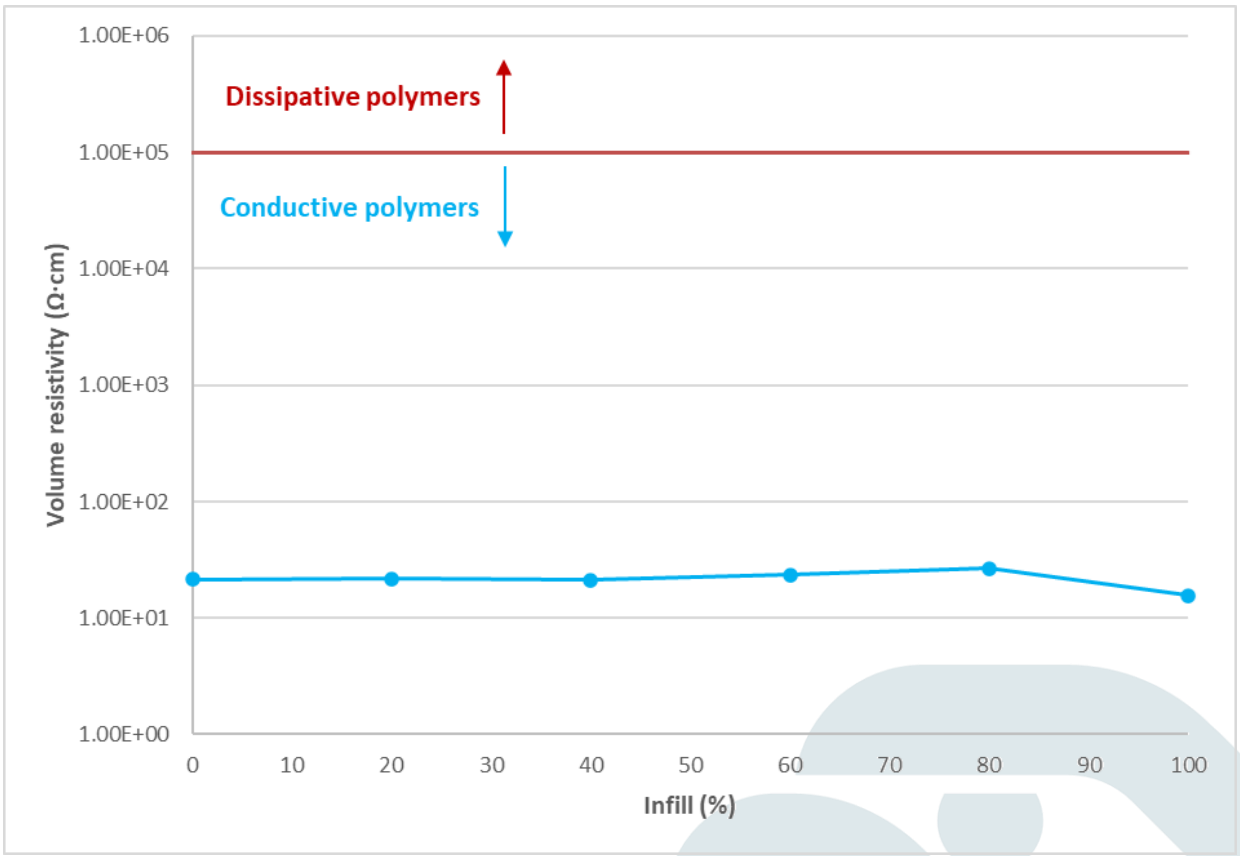

*Figure 1: Test illustration - Milli-TO3 ohmmeter connected with four-pole electrode 4P-1*

# 4. Results and commentary

Results from all analyses are shown in *Table 1*.

*Table 1: Volume resistivity of delivered 3D printed samples in horizontal and vertical arrangement according to ČSN EN ISO 3915*

| Specimen | **100%** | **80%** | **60%** | **40%** | **20%** | **0%** |
|---|---|---|---|---|---|---|
| 1 | 15.84 | 28.39 | 23.50 | 21.70 | 21.55 | 22.15 |
| 2 | 15.35 | 26.07 | 23.42 | 20.53 | 20.49 | 21.47 |
| 3 | 16.39 | 26.08 | 23.76 | 20.95 | 21.56 | 21.25 |
| 4 | 15.30 | 27.68 | 22.97 | 21.27 | 23.37 | 20.84 |
| 5 | 15.70 | 25.13 | 23.47 | 21.26 | 22.12 | 21.16 |
| **Average Volume resistivity (Ω·cm)** | **(1.6 ± 0.0) ·10¹** | **(2.7 ± 0.1) ·10¹** | **(2.3 ± 0.0) ·10¹** | **(2.1 ± 0.0) ·10¹** | **(2.2 ± 0.1) ·10¹** | **(2.1 ± 0.0) ·10¹** |



The results above suggest, that there is only a minor difference in the volume resistivity performance. The influence of the infill is minor and the main role is overtaken by the quality of the external shell. That means mainly by quality of perimeters and bottom and top layers.

## 5. Conclusion

PIB has measured the volume resistivity on specimens printed from ESD PETG filament with various infill ratio. Measured values difference is minor and the overall performance is reaching similar values among all samples. Throughout the whole range of infill ratios, the material reaches far below the conductive polymers threshold. These values are approximately $10^1$ Ω·cm.

*Author confirms the data accuracy and correctness related only to the measured and evaluated samples. Commentary and conclusion is based on the experimental data gathered throughout the arranged experiments. It is not allowed to misinterpret any results or share any part of them unless the whole report is reproduced.*

In Brno

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