Supplementary Information

Evaluation of Pore-Former Size and Volume Fraction on Tape Cast Porous 430 Stainless Steel Substrates for Plasma Spraying

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Concentration: 0.0087 %Vol   **Span :** 1.375   **Uniformity:** 0.466   **Result units:** Volume

Specific Surface Area: 0.183 m²/g   **Surface Weighted Mean D[3,2]:** 4.214 um   **Vol. Weighted Mean D[4,3]:** 6.528 um

d(0.1): 2.934 um   **d(0.5):** 5.665 um   **d(0.9):** 10.721 um
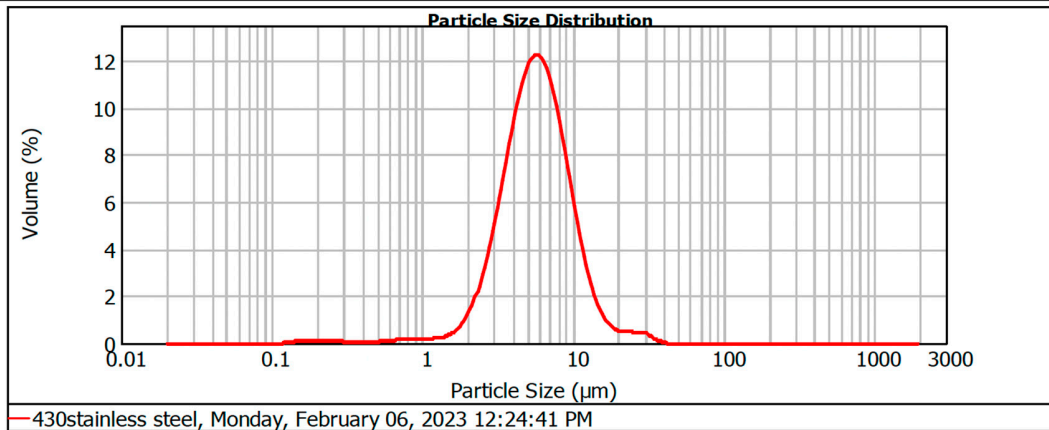
430stainless steel, Monday, February 06, 2023 12:24:41 PM

Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %
0.010	0.00	0.105	0.00	1.096	0.18	11.482	2.98	120.226	0.00	1258.925	0.00
0.011	0.00	0.120	0.03	1.259	0.22	13.183	1.73	138.038	0.00	1445.440	0.00
0.013	0.00	0.138	0.07	1.445	0.34	15.136	0.97	158.489	0.00	1659.587	0.00
0.015	0.00	0.158	0.10	1.660	0.63	17.378	0.58	181.970	0.00	1905.461	0.00
0.017	0.00	0.182	0.12	1.905	1.17	19.953	0.45	208.930	0.00	2187.762	0.00
0.020	0.00	0.209	0.11	2.188	2.07	22.909	0.43	239.883	0.00	2511.886	0.00
0.023	0.00	0.240	0.09	2.512	3.38	26.303	0.42	275.423	0.00	2884.032	0.00
0.026	0.00	0.275	0.06	2.884	5.04	30.200	0.26	316.228	0.00	3311.311	0.00
0.030	0.00	0.316	0.04	3.311	6.90	34.674	0.09	363.078	0.00	3801.894	0.00
0.035	0.00	0.363	0.03	3.802	8.71	39.811	0.00	416.869	0.00	4365.158	0.00
0.040	0.00	0.417	0.04	4.365	10.17	45.709	0.00	478.630	0.00	5011.872	0.00
0.046	0.00	0.479	0.06	5.012	10.97	52.481	0.00	549.541	0.00	5754.399	0.00
0.052	0.00	0.550	0.09	5.754	10.94	60.256	0.00	630.957	0.00	6606.934	0.00
0.060	0.00	0.631	0.13	6.607	10.08	69.183	0.00	724.436	0.00	7585.776	0.00
0.069	0.00	0.724	0.16	7.586	8.53	79.433	0.00	831.764	0.00	8709.636	0.00
0.079	0.00	0.832	0.17	8.710	6.62	91.201	0.00	954.993	0.00	10000.000	0.00
0.091	0.00	0.955	0.18	10.000	4.65	104.713	0.00	1096.478	0.00		
0.105		1.096		11.482		120.226		1258.925			

Figure S1. Particle size analysis report for 430L powder.

Concentration:	Span :	Uniformity:	Result units:
0.0463 %Vol	0.629	0.195	Volume

Specific Surface Area:	Surface Weighted Mean D[3,2]:	Vol. Weighted Mean D[4,3]:
0.322 m²/g	18.660 um	19.738 um

d(0.1): 14.144 um   **d(0.5):** 19.188 um   **d(0.9):** 26.211 um
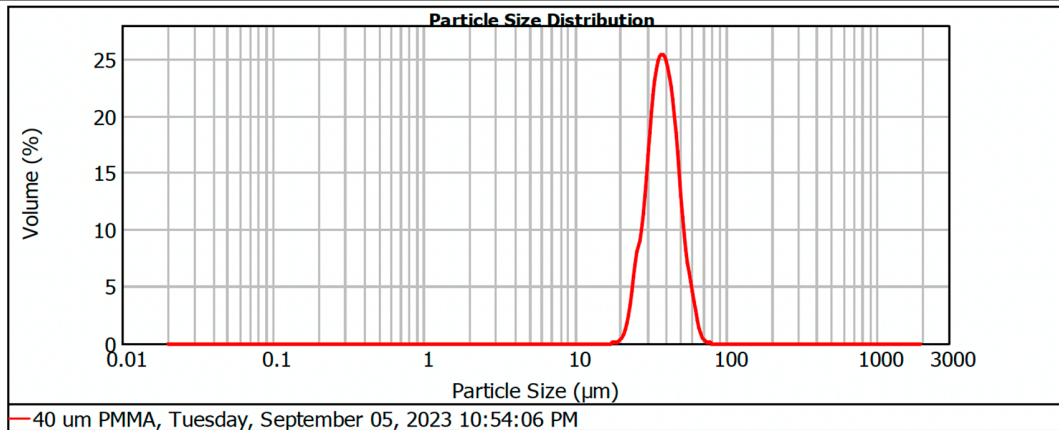

Particle Size Distribution
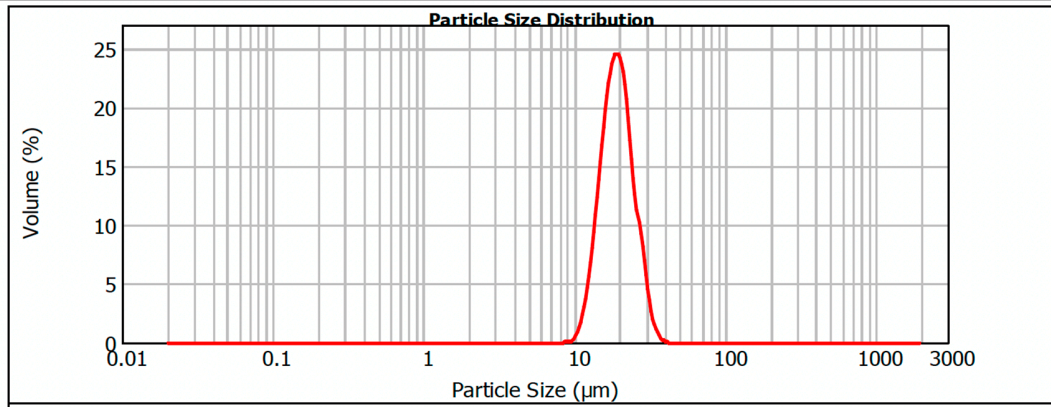
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Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %
0.010	0.00	0.105	0.00	1.096	0.00	11.482	4.35	120.226	0.00	1258.925	0.00
0.011	0.00	0.120	0.00	1.259	0.00	13.183	10.73	138.038	0.00	1445.440	0.00
0.013	0.00	0.138	0.00	1.445	0.00	15.136	18.06	158.489	0.00	1659.587	0.00
0.015	0.00	0.158	0.00	1.660	0.00	17.378	22.09	181.970	0.00	1905.461	0.00
0.017	0.00	0.182	0.00	1.905	0.00	19.953	20.77	208.930	0.00	2187.762	0.00
0.020	0.00	0.209	0.00	2.188	0.00	22.909	13.14	239.883	0.00	2511.886	0.00
0.023	0.00	0.240	0.00	2.512	0.00	26.303	7.36	275.423	0.00	2884.032	0.00
0.026	0.00	0.275	0.00	2.884	0.00	30.200	2.04	316.228	0.00	3311.311	0.00
0.030	0.00	0.316	0.00	3.311	0.00	34.674	0.35	363.078	0.00	3801.894	0.00
0.035	0.00	0.363	0.00	3.802	0.00	39.811	0.00	416.869	0.00	4365.158	0.00
0.040	0.00	0.417	0.00	4.365	0.00	45.709	0.00	478.630	0.00	5011.872	0.00
0.046	0.00	0.479	0.00	5.012	0.00	52.481	0.00	549.541	0.00	5754.399	0.00
0.052	0.00	0.550	0.00	5.754	0.00	60.256	0.00	630.957	0.00	6606.934	0.00
0.060	0.00	0.631	0.00	6.607	0.00	69.183	0.00	724.436	0.00	7585.776	0.00
0.069	0.00	0.724	0.00	7.586	0.00	79.433	0.00	831.764	0.00	8709.636	0.00
0.079	0.00	0.832	0.00	8.710	0.07	91.201	0.00	954.993	0.00	10000.000	0.00
0.091	0.00	0.955	0.00	10.000	1.04	104.713	0.00	1096.478	0.00		
0.105		1.096		11.482		120.226		1258.925			

Figure S2. Particle size analysis report for PF20 powder.

Particle Size Distribution

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Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %	Size (μm)	Volume In %
0.010	0.00	0.105	0.00	1.096	0.00	11.482	0.00	120.226	0.00	1258.925	0.00
0.011	0.00	0.120	0.00	1.259	0.00	13.183	0.00	138.038	0.00	1445.440	0.00
0.013	0.00	0.138	0.00	1.445	0.00	15.136	0.00	158.489	0.00	1659.587	0.00
0.015	0.00	0.158	0.00	1.660	0.00	17.378	0.05	181.970	0.00	1905.461	0.00
0.017	0.00	0.182	0.00	1.905	0.00	19.953	0.67	208.930	0.00	2187.762	0.00
0.020	0.00	0.209	0.00	2.188	0.00	22.909	4.73	239.883	0.00	2511.886	0.00
0.023	0.00	0.240	0.00	2.512	0.00	26.303	10.20	275.423	0.00	2884.032	0.00
0.026	0.00	0.275	0.00	2.884	0.00	30.200	19.22	316.228	0.00	3311.311	0.00
0.030	0.00	0.316	0.00	3.311	0.00	34.674	22.92	363.078	0.00	3801.894	0.00
0.035	0.00	0.363	0.00	3.802	0.00	39.811	20.76	416.869	0.00	4365.158	0.00
0.040	0.00	0.417	0.00	4.365	0.00	45.709	13.53	478.630	0.00	5011.872	0.00
0.046	0.00	0.479	0.00	5.012	0.00	52.481	5.95	549.541	0.00	5754.399	0.00
0.052	0.00	0.550	0.00	5.754	0.00	60.256	1.86	630.957	0.00	6606.934	0.00
0.060	0.00	0.631	0.00	6.607	0.00	69.183	0.11	724.436	0.00	7585.776	0.00
0.069	0.00	0.724	0.00	7.586	0.00	79.433	0.00	831.764	0.00	8709.636	0.00
0.079	0.00	0.832	0.00	8.710	0.00	91.201	0.00	954.993	0.00	10000.000	
0.091	0.00	0.955	0.00	10.000	0.00	104.713	0.00	1096.478	0.00		
0.105		1.096		11.482		120.226		1258.925			

Figure S3. Particle size analysis report for PF40 powder.

Concentration:	**Span :**	**Uniformity:**	**Result units:**
0.1286 %Vol	0.749	0.235	Volume
Specific Surface Area:	**Surface Weighted Mean D[3,2]:**	**Vol. Weighted Mean D[4,3]:**	
0.106 m²/g	56.776 um	61.466 um	

d(0.1):   40.955   um   **d(0.5):   59.101   um**   **d(0.9):   85.209   um**

Particle Size Distribution

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Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %
0.010		0.105		1.096		11.482		120.226		1258.925	
0.011	0.00	0.120	0.00	1.259	0.00	13.183	0.00	138.038	0.18	1445.440	0.00
0.013	0.00	0.138	0.00	1.445	0.00	15.136	0.00	158.489	0.00	1659.587	0.00
0.015	0.00	0.158	0.00	1.660	0.00	17.378	0.00	181.970	0.00	1905.461	0.00
0.017	0.00	0.182	0.00	1.905	0.00	19.953	0.00	208.930	0.00	2187.762	0.00
0.020	0.00	0.209	0.00	2.188	0.00	22.909	0.00	239.883	0.00	2511.886	0.00
0.023	0.00	0.240	0.00	2.512	0.00	26.303	0.02	275.423	0.00	2884.032	0.00
0.026	0.00	0.275	0.00	2.884	0.00	30.200	0.49	316.228	0.00	3311.311	0.00
0.030	0.00	0.316	0.00	3.311	0.00	34.674	2.17	363.078	0.00	3801.894	0.00
0.035	0.00	0.363	0.00	3.802	0.00	39.811	5.60	416.869	0.00	4365.158	0.00
0.040	0.00	0.417	0.00	4.365	0.00	45.709	10.51	478.630	0.00	5011.872	0.00
0.046	0.00	0.479	0.00	5.012	0.00	52.481	15.46	549.541	0.00	5754.399	0.00
0.052	0.00	0.550	0.00	5.754	0.00	60.256	18.39	630.957	0.00	6606.934	0.00
0.060	0.00	0.631	0.00	6.607	0.00	69.183	17.89	724.436	0.00	7585.776	0.00
0.069	0.00	0.724	0.00	7.586	0.00	79.433	14.21	831.764	0.00	8709.636	0.00
0.079	0.00	0.832	0.00	8.710	0.00	91.201	9.05	954.993	0.00	10000.000	
0.091	0.00	0.955	0.00	10.000	0.00	104.713	4.50	1096.478	0.00		
0.105	0.00	1.096	0.00	11.482	0.00	120.226	1.53	1258.925	0.00		

Figure S4. Particle size analysis report for PF60 powder.

Concentration:
0.2427   %Vol

Span :
0.838

Uniformity:
0.262

Result units:
Volume

Specific Surface Area:
0.0671   m²/g

Surface Weighted Mean D[3,2]:
89.430   um

Vol. Weighted Mean D[4,3]:
98.570   um

d(0.1):   62.262   um   **d(0.5):**   94.206   um   **d(0.9):**   141.221   um
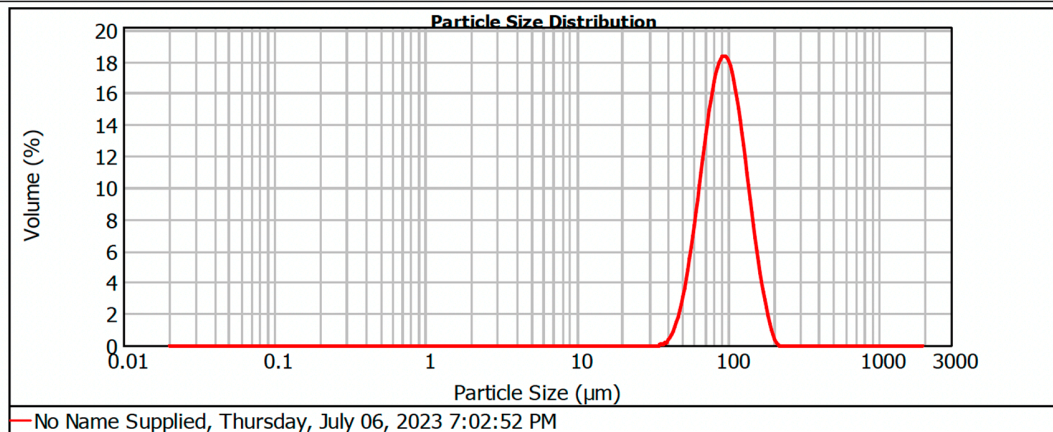
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Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %	Size (µm)	Volume In %
0.010	0.00	0.105	0.00	1.096	0.00	11.482	0.00	120.226	11.21	1258.925	0.00
0.011	0.00	0.120	0.00	1.259	0.00	13.183	0.00	138.038	7.00	1445.440	0.00
0.013	0.00	0.138	0.00	1.445	0.00	15.136	0.00	158.489	3.46	1659.587	0.00
0.015	0.00	0.158	0.00	1.660	0.00	17.378	0.00	181.970	0.97	1905.461	0.00
0.017	0.00	0.182	0.00	1.905	0.00	19.953	0.00	208.930	0.00	2187.762	0.00
0.020	0.00	0.209	0.00	2.188	0.00	22.909	0.00	239.883	0.00	2511.886	0.00
0.023	0.00	0.240	0.00	2.512	0.00	26.303	0.00	275.423	0.00	2884.032	0.00
0.026	0.00	0.275	0.00	2.884	0.00	30.200	0.00	316.228	0.00	3311.311	0.00
0.030	0.00	0.316	0.00	3.311	0.00	34.674	0.05	363.078	0.00	3801.894	0.00
0.035	0.00	0.363	0.00	3.802	0.00	39.811	0.68	416.869	0.00	4365.158	0.00
0.040	0.00	0.417	0.00	4.365	0.00	45.709	2.31	478.630	0.00	5011.872	0.00
0.046	0.00	0.479	0.00	5.012	0.00	52.481	5.19	549.541	0.00	5754.399	0.00
0.052	0.00	0.550	0.00	5.754	0.00	60.256	9.06	630.957	0.00	6606.934	0.00
0.060	0.00	0.631	0.00	6.607	0.00	69.183	13.00	724.436	0.00	7585.776	0.00
0.069	0.00	0.724	0.00	7.586	0.00	79.433	15.83	831.764	0.00	8709.636	0.00
0.079	0.00	0.832	0.00	8.710	0.00	91.201	16.50	954.993	0.00	10000.000	0.00
0.091	0.00	0.955	0.00	10.000	0.00	104.713	14.75	1096.478	0.00		
0.105		1.096		11.482		120.226		1258.925			

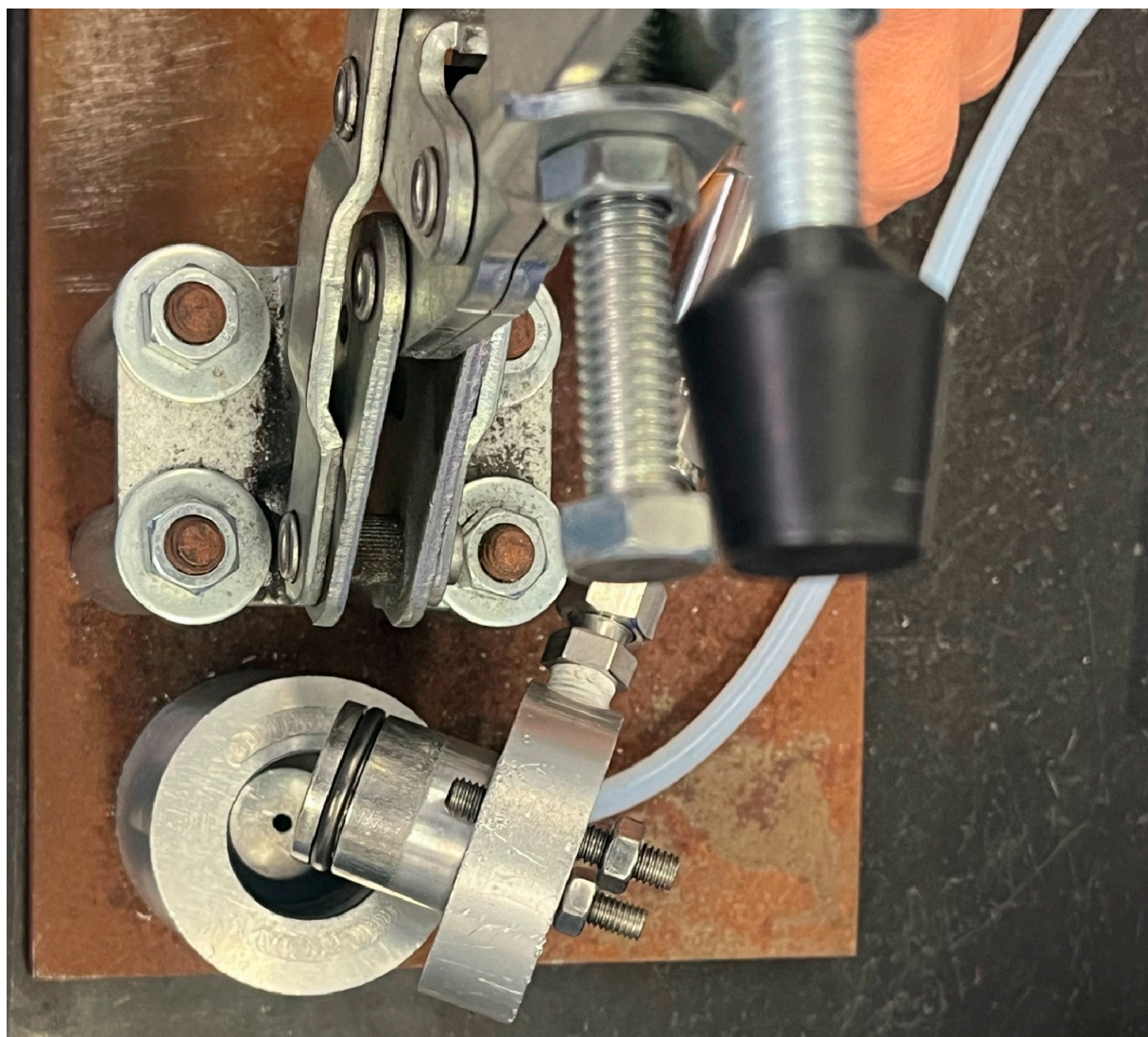Figure S5. Particle size analysis report for PF90 powder.

Figure S6. Gas permeability measuring apparatus.

```python
"""Python script to analysis surface profile"""
import xml.etree.ElementTree as ET
import os
import statistics


def extract_profile_data(file_path):
    """Extract X and Z coordinates from an XML file."""
    tree = ET.parse(file_path)
    root = tree.getroot()

    x_data = root.findall(".//DataBlock/Data/X")
    z_data = root.findall(".//DataBlock/Data/Z")

    profile = [{"x": float(x_data[i].text), "z": float(z_data[i].text)} for i in range(len(x_data))]
    return profile


def detect_pits(profile):
    """Detect pits based on the Z profile."""
    pits = []
    start_x = None
    start_z = None

    for i, point in enumerate(profile[:-1]):
        current_z = point["z"]
        next_z = profile[i + 1]["z"]

        if current_z > next_z and start_x is None:
            start_x = point["x"]
            start_z = current_z
```

```python
        elif current_z < next_z and start_x is not None:
            pits.append({
                "width": point["x"] - start_x,
                "depth": start_z - current_z
            })

            start_x = None
            start_z = None
    """Although the function only tracked the descending part of the profile, the start of a
pit is only updated until the descending profile is finished, so the pit width reported here
still covers the length of a descending and an ascending profile"""
    return pits


if __name__ == "__main__":
    directory = "empty"
    threshold_depth = 10  # Adjust this value to filter out smaller pits

    pits = []

    for filename in os.listdir(directory):
        if filename.endswith(".xml"):
            profile = extract_profile_data(os.path.join(directory, filename))
            pits += detect_pits(profile)

    major_pits = [pit for pit in pits if pit["depth"] > threshold_depth]
    major_widths = [pit["width"] for pit in major_pits]
    major_depths = [pit["depth"] for pit in major_pits]

    avg_major_width = sum(major_widths) / len(major_widths) if major_widths else 0
```

```python
avg_major_depth = sum(major_depths) / len(major_depths) if major_depths else 0
std_dev_width = statistics.stdev(major_widths) if len(major_widths) > 1 else 0
std_dev_depth = statistics.stdev(major_depths) if len(major_depths) > 1 else 0
largest_pit = max(pits, key=lambda pit: pit["depth"]) if pits else {"width": 0, "depth": 0}

print("Average major pit width:", avg_major_width)
print("Average major pit depth:", avg_major_depth)
print("Standard Deviation of major pit width:", std_dev_width)
print("Standard Deviation of major pit depth:", std_dev_depth)
print("Largest pit - Width:", largest_pit["width"], "Depth:", largest_pit["depth"])
```