

**Metropolitan Museum of Art**  
**Gas Chromatography- Mass Spectrometry (GC-MS) Results from Material Analysis**

This document includes (1) a mass spectrum and (2) the volatile organic compounds (VOCs) emitted from samples using GC-MS analysis. The data is not interpreted; however, several classes of chemicals are highlighted because they are potential risks for artwork in an enclosed environment. A basic key, provided below, indicates those classes. The amount of each chemical identified has not been determined; similarly, it is not known how much of each chemical is necessary to do damage to art. Finally, peaks may be present that are the result of the sample adsorbing chemicals from the air and reemitting them during testing rather than being inherent to the sample. Research is ongoing to determine specifically which chemicals and amounts are required to negatively affect artifacts.

**Highlighted data:**

Pink – chemicals currently known to be hazardous to art

Green – amines; can raise the pH, are suspected to react with acids and may form crystals in an enclosed environment

Yellow – chemicals of the following type, which *may* be hazardous to art:

*Acids* – lower the pH, corrosive to metals, degrade organic materials

*Aldehydes* – can convert to acids with heat or exposure to UV light

*Esters* – can hydrolyze into acids with heat and humidity

*Sulfur-containing compounds* – known to tarnish and corrode some metals

*Halogenated compounds* – can become reactive with exposure to heat and UV light

*Nitrogen-containing, not amine* – can react with other off-gassed chemicals

*Alkynes* – can become reactive when exposed to heat or UV light

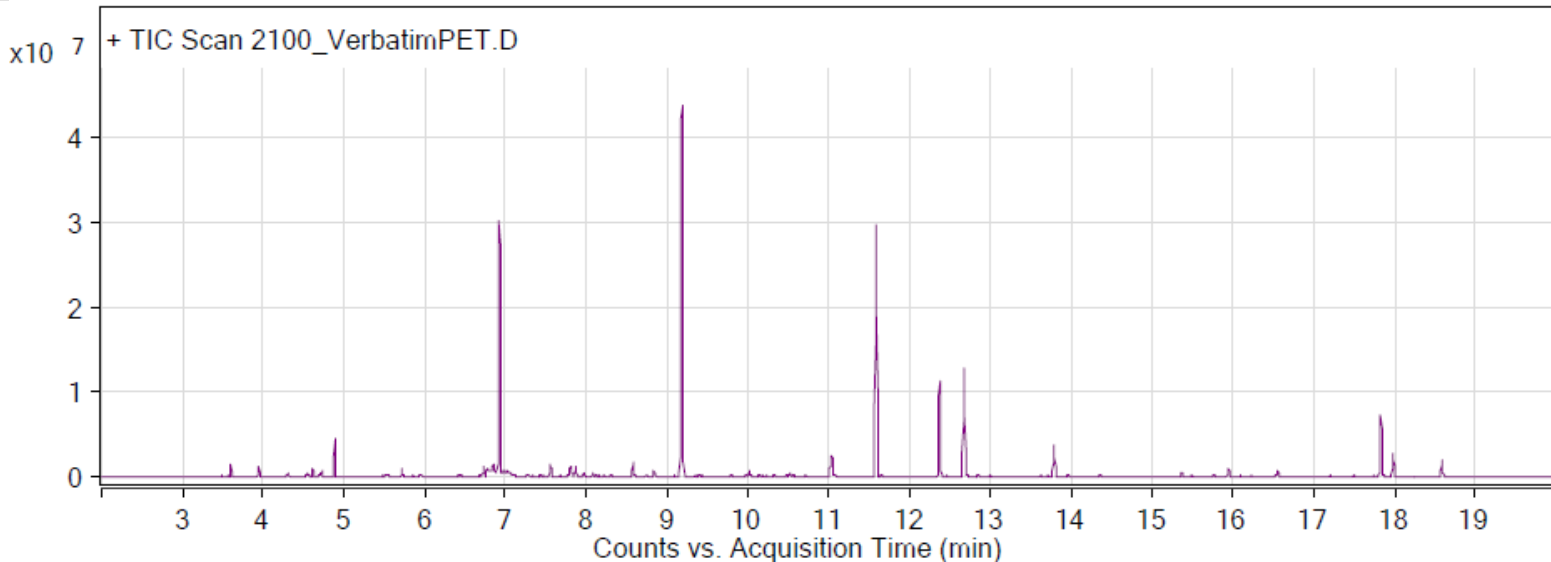
Sample: Verbatim 3D printed polyethylene terephthalate filament

Oddy test result: Temporary

Date collected: 03/19/2018

Technique used: SPME with a PDMS/DVB fiber; Agilent 7890B GC and 5977B MS fitted with a GL Sciences OPTIC-4 multimode inlet and LEAP PAL RTC autosampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and crotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Samples > 85% match with a NIST 17.0 or Wiley 9 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.6	98.01	1192600	Acetic acid	C2H4O2
3.95	95.09	837104	Silanediol, dimethyl-	C2H8O2Si
4.73	93.23	1520240	Propanoic acid, 2,2-dimethyl-	C5H10O2
4.89	92.45	3365627	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.54	95.27	746616	Pentanoic acid	C5H10O2
5.72	85.38	850130	Oxime-, methoxy-phenyl-	C8H9NO2
6.92	96.2	32520081	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.55	94.89	2101738	2-Propanol, 1,1'-oxybis-	C6H14O3
7.8	94.92	918191	Benzyl Alcohol	C7H8O
7.81	94.06	1133615	2-Propanol, 1,1'-oxybis-	C6H14O3
7.86	96.15	1491468	2-Propanol, 1,1'-oxybis-	C6H14O3
8.83	94.47	980895	Nonanal	C9H18O
9.18	96.5	67004785	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
10.01	93.1	829025	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
11.04	94.89	4819932	Caprolactam	C6H11NO
11.59	96.15	40436878	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
12.37	89.5	15004818	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	94.09	17458632	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
15.94	97.97	1325680	Methanone, diphenyl-	C13H10O
16.55	96.94	1166485	alpha-Bisabolol	C15H26O
17.83	97.55	9663591	2-Ethylhexyl salicylate	C15H22O3
17.98	95.42	3883706	Isopropyl myristate	C17H34O2
18.59	97.36	2658219	1-Hexadecanol	C16H34O
19.99	94.41	1622079	Isopropyl palmitate	C19H38O2