

**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

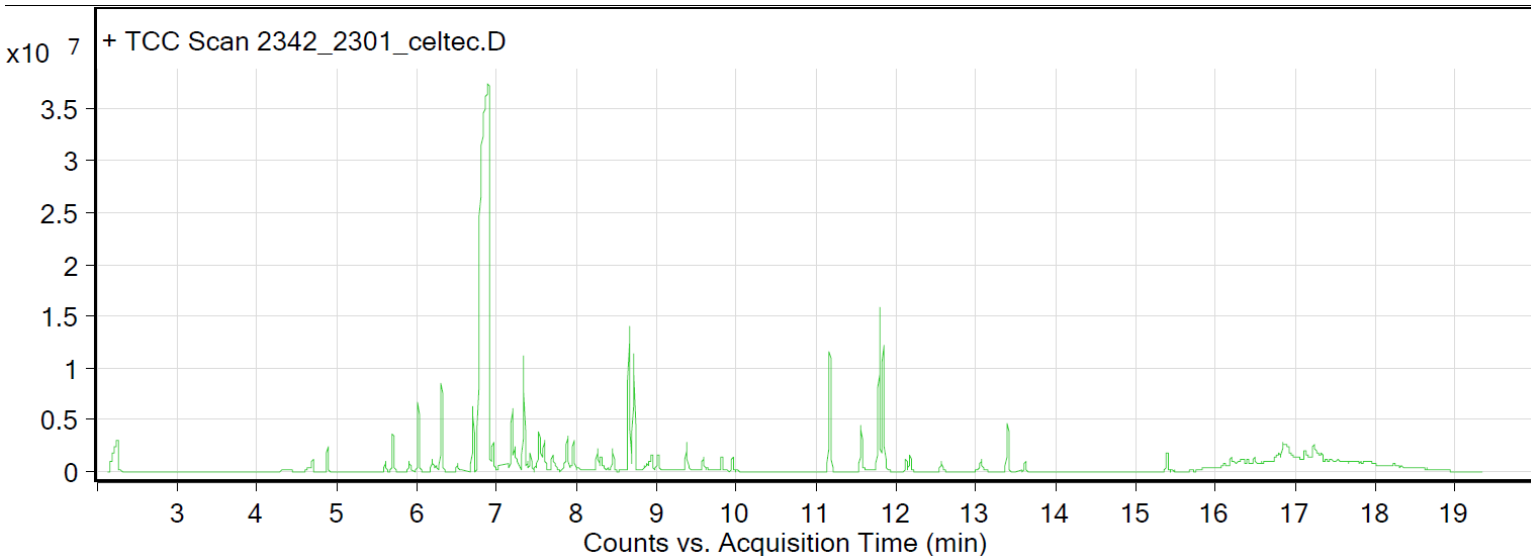
Sample: Tesa 4200 silicone single sided red tape

Oddy test result: unsuitable

Date collected: 10/24/2018

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 cryo-trapped for 2 min at -15°C; GC ramped from 35°C to 250 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Deconvoluted data with > 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) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid.



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.25	85.36	13121073	Acetaldehyde	C2H4O
4.69	95.04	2992440	2-Propenoic acid, butyl ester	C7H12O2
4.89	96.12	3169099	Propanoic acid, butyl ester	C7H14O2
5.7	92.13	4472197	Octane, 2,2,6-trimethyl-	C11H24
5.71	91.82	1531565	Benzaldehyde	C7H6O
5.9	92.83	1750979	Octane, 2,2,6-trimethyl-	C11H24
6.02	93.45	9596353	n-Butyl methacrylate	C8H14O2
6.19	93.63	1508915	Sulfurous acid, 2-ethylhexyl hexyl ester	C14H30O3S
6.31	96.16	14287414	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.5	91.33	1475423	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
6.71	92.59	9512985	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
7.2	90.92	10534993	Dodecane, 2,6,11-trimethyl-	C15H32
7.23	90.69	2317470	Dodecane, 2,6,11-trimethyl-	C15H32
7.34	91.64	9162348	Dodecane, 2,6,11-trimethyl-	C15H32
7.43	87.14	1591712	Dodecane, 2,6,11-trimethyl-	C15H32
7.6	87.43	2530510	Formic acid, 2-ethylhexyl ester	C9H18O2
7.7	87.48	2192454	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
7.88	93.88	6467654	Undecane	C11H24
7.96	97.14	4597817	Nonanal	C9H18O
8.26	87.89	1696709	Decane, 2,2,6-trimethyl-	C13H28
8.45	97.35	3315462	Pentanedioic acid, dimethyl ester	C7H12O4
8.66	96.17	21568334	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	94.56	14913042	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.94	90.63	1841387	UNDECANE, 3-METHYL-	C12H26
9.02	97.95	2426359	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./-./-)	C10H20O
9.38	93.74	4376978	Dodecane	C12H26
9.59	88.86	2383022	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O

9.82	95.55	2250269	2-Ethylhexyl acrylate	C11H20O2
9.95	91.16	2025251	2-Ethyl-1-hexyl propionate	C11H22O2
11.17	95.68	21637287	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.56	91.61	8258179	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.79	85.75	16950831	Propanoic acid, octyl ester	C11H22O2
11.84	92.78	12306850	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.12	95.48	1765818	Tetradecane	C14H30
12.57	90.22	1793740	2-Ethylhexyl mercaptoacetate	C10H20O2S
13.62	96.92	1486156	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
15.39	90.59	3394170	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8