

**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

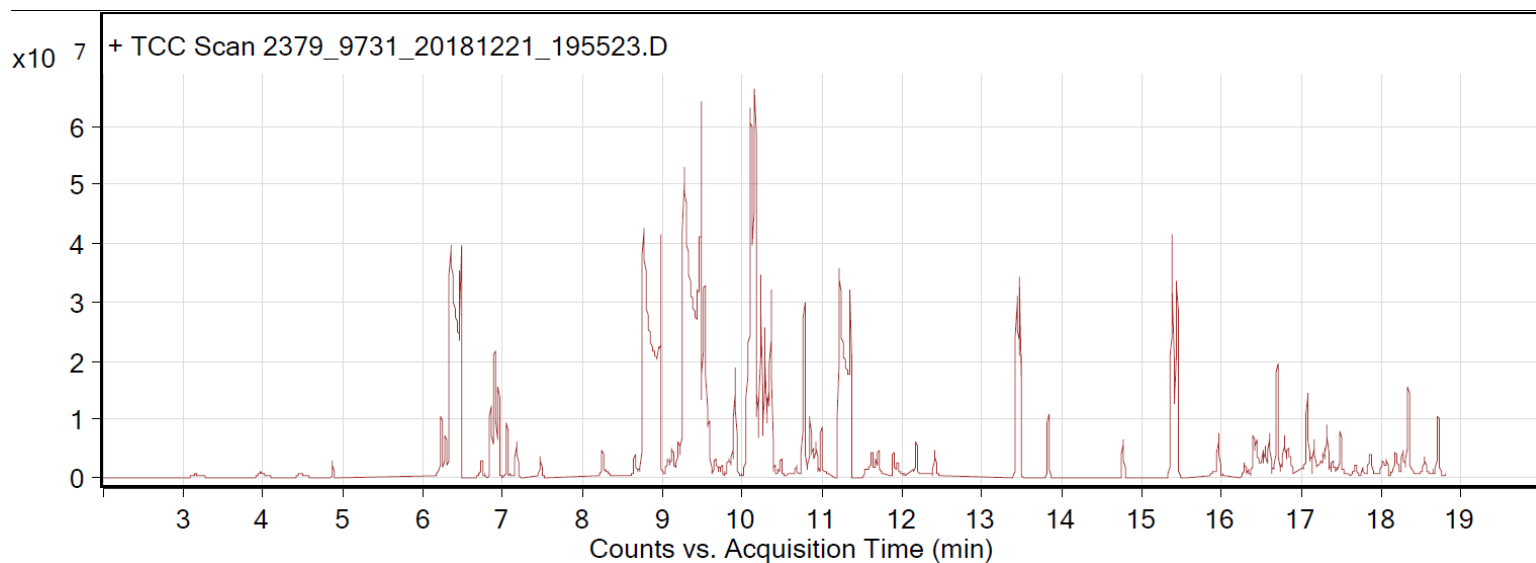
Sample: 3M 9731 double-sided adhesive

Oddy test result: temporary

Date collected: 12/21/2018

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) 11.9 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid.



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.76	97.34	8969559	Benzene, methyl-	C7H8
3.15	91.67	5729034	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.96	97.57	6422239	XYLENE	C8H10
4.47	96.38	4468900	XYLENE	C8H10
4.87	96.47	4024906	Ethanol, 2-butoxy-	C6H14O2
6.23	94.75	18825729	Isooctanol	C8H18O
6.28	87.35	4135066	Benzene, 1,3,5-trimethyl-	C9H12
6.29	89.45	5282218	Isooctanol	C8H18O
6.46	89.35	13198913	(R)-4-(1-ethoxyethoxy)-3-fluoro-4-methyl-1-pentanol acetate	C12H23FO4
6.73	95.43	5327646	3-Ethyl-4-methylpentan-1-ol	C8H18O
6.9	91.98	19132677	1-Heptanol, 3-methyl-	C8H18O
6.95	91.81	29674112	1-Heptanol, 4-methyl-	C8H18O
7.05	96.92	13619965	5-Methyl-1-heptanol	C8H18O
7.17	94.15	13313945	Tetrasiloxane, decamethyl-	C10H30O3Si4
7.47	97.64	5591521	1-Octanol	C8H18O
8.25	89.24	10267592	1-Heptanol, 6-methyl-	C8H18O
8.76	91.17	247140412	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.12	85.57	5844577	6-Methyloctyl acetate	C11H22O2
9.27	96.05	390416825	Pentasiloxane, dodecamethyl-	C12H36O4Si5
9.53	87.29	101633554	2-Propenoic acid, octyl ester	C11H20O2
9.91	85.16	40469601	3-Ethyl-4-methylpentan-1-ol	C8H18O
10.23	86.78	61665943	2-PROPENOIC ACID, ISODECYL ESTER	C13H24O2
10.28	91.68	44359529	acrylic acid dodecanyl ester	C15H28O2
10.36	89.39	61528916	(S)-(+)-5-Methyl-1-heptanol	C8H18O
10.48	88.55	5585958	Formic acid, 2-ethylhexyl ester	C9H18O2
10.68	87.15	4013432	1-Undecanol	C11H24O
10.85	95.08	10340066	Tridecane	C13H28
11.22	95.83	210634896	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.7	94.27	5258220	Phenol, 2-(1,1-dimethylethyl)-5-methyl-	C11H16O
11.9	92.52	4083461	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3

11.94	89.93	4021520	Longicyclene	C15H24
12.18	89.16	10505988	2H-2,4a-Methanonaphthalene, 1,3,4,5,6,7-hexahydro-1,1,5,5- tetramethyl-, (2S)-	C15H24
12.41	96.87	8194770	Longifolene	C15H24
13.83	93.54	18134768	Calamenene	C15H22
15.44	88.34	74275657	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
18.34	96.96	33296811	(1S,4aS,4bS,7S,8aS,10aS)-7-Isopropyl- 1,4a- dimethyltetradecahydrophenanthrene	C19H34
18.71	88.47	21915953	(1S,4aS,4bS,7S,8aS,10aS)-7-Isopropyl- 1,4a- dimethyltetradecahydrophenanthrene	C19H34