

**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

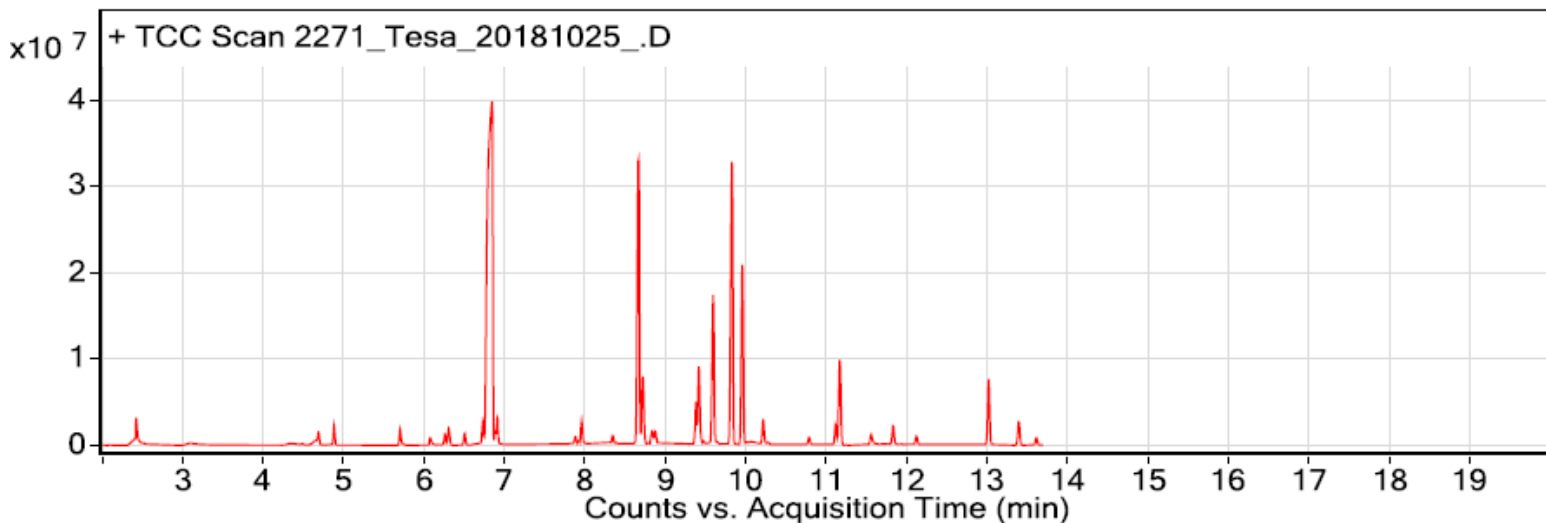
*Alkynes* – can become reactive when exposed to heat or UV light

Sample: Tesa tape 51575

Date collected: 08/17/2018

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. Samples > 80% match with a NIST 17.0 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 11.5 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



RT	Score	Formula	MW	Area	CAS #	Name
1.510	97.8	C2H4O2	60.0	1643624	64-19-7	Acetic acid
1.710	93.8	C7H8	92.1	1434425	108-88-3	Benzene, methyl-
2.420	96.1	C4H11NO	89.1	5499379	108-01-0	N,N-Dimethylaminoethanol
3.100	90.0	C6H18O3Si3	222.1	2613287	541-05-9	Cyclotrisiloxane, hexamethyl-
4.690	95.0	C7H12O2	128.1	4153327	141-32-2	2-Propenoic acid, butyl ester
4.880	96.0	C7H14O2	130.1	2900502	590-01-2	Propanoic acid, butyl ester
5.710	97.2	C7H6O	106.0	2834034	100-52-7	Benzaldehyde
6.080	90.1	C6H10O2	114.1	1604887	13861-97-7	2(3H)-Furanone, dihydro-4,4-dimethyl-
6.260	96.2	C8H16O2	144.1	1920452	109-21-7	Butanoic acid, butyl ester
6.310	96.0	C8H24O4Si4	296.1	2775772	556-67-2	Cyclotetrasiloxane, octamethyl-
6.510	96.2	C10H16	136.1	2012828	13466-78-9	.DELTA.3-Carene
6.730	94.8	C10H14	134.1	3683976	25155-15-1	Benzene, methyl(1-methylethyl)-
6.850	85.2	C10H22O	158.2	129598327	112-30-1	1-Decanol
7.880	92.3	C11H24	156.2	1674406	1120-21-4	Undecane
7.960	97.9	C9H18O	142.1	4318979	124-19-6	Nonanal
8.350	86.9	C12H22O3	214.2	1628416	1000382-54-0	Carbonic acid, octyl prop-1-en-2-yl ester
8.670	96.7	C10H20O2	172.1	60570132	103-09-3	Acetic acid, 2-ethylhexyl ester
8.720	94.3	C10H30O5Si5	370.1	10165831	541-02-6	Cyclopentasiloxane, decamethyl-
8.880	83.4	C10H20O2	172.1	1634419	112-14-1	Acetic acid, octyl ester
9.380	91.5	C12H26	170.2	4269019	112-40-3	Dodecane
9.420	93.9	C10H20O	156.2	9959715	937-05-3	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-
9.600	95.7	C10H20O	156.2	29595751	21862-63-5	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-
9.830	95.4	C11H20O2	184.1	59159119	103-11-7	2-Ethylhexyl acrylate
9.960	91.5	C11H22O2	186.2	35161341	999145-46-3	2-Ethyl-1-hexyl propionate
10.220	92.5	C10H16N2	164.1	4806793	999094-51-6	2,3-Diethyl-2,3-dimethylsuccinonitrile
10.790	92.7	C13H28	184.2	1348486	629-50-5	Tridecane
11.120	93.9	C12H24O2	200.2	3823251	25415-84-3	n-Butyric acid 2-ethylhexyl ester
11.170	96.2	C12H36O6Si6	444.1	18013186	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.560	86.0	C12H24O3	216.2	2397989	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.830	93.2	C12H24O3	216.2	3973583	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.120	95.2	C14H30	198.2	1560056	629-59-4	Tetradecane
13.400	80.4	C14H42O7Si7	518.1	4939121	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.610	97.2	C15H24O	220.2	1388723	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-