

**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

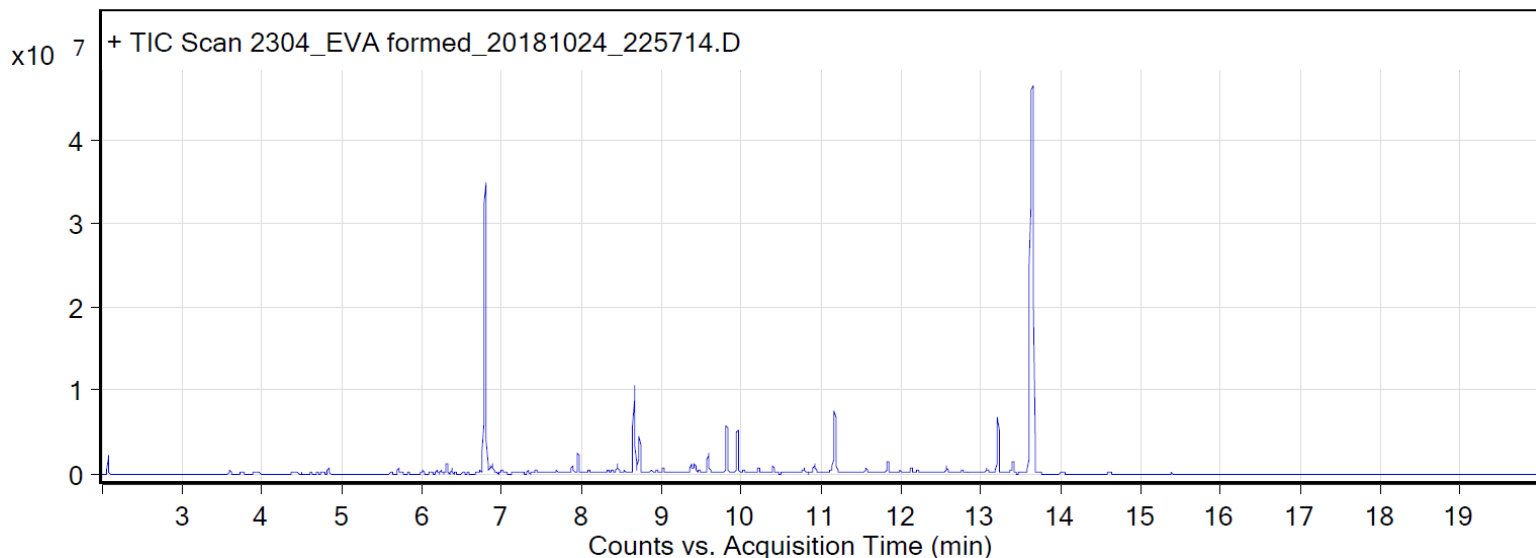
Sample: Keystone Industries: Soft EVA .040 (1mm), #9596980; Pro-form formed plastic; Ethyl vinyl acetate; thickness: 0.040" (1mm);

Oddy test result: Temporary

Date collected: 10/23/2018

Technique used: SPME with a PDMS/Carbon WR 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; (3) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.07	93.71	1928571	Silanediol, dimethyl-	C2H8O2Si
4.83	96.81	968494	Ethanol, 2-butoxy-	C6H14O2
5.71	92.51	1148941	Benzaldehyde	C7H6O
6.31	96.15	1376091	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.8	92.45	70200796	1-Hexanol, 2-ethyl-	C8H18O
6.86	93.05	955436	Butanedioic acid, dimethyl ester	C6H10O4
7.88	94.98	1448757	Undecane	C11H24
7.96	97.92	3589920	Nonanal	C9H18O
8.45	96.99	1571897	Pentanedioic acid, dimethyl ester	C7H12O4
8.66	96.19	15555639	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	94.35	6613467	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.38	88.53	1804972	Dodecane	C12H26
9.41	89.85	1633129	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.58	93.7	3548980	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.82	95.74	8138422	2-Ethylhexyl acrylate	C11H20O2
9.95	91.51	7354974	2-Ethyl-1-hexyl propionate	C11H22O2
10.4	94.22	1262493	Carbonic acid, octyl vinyl ester	C11H20O3
10.79	93.11	1000735	Tridecane	C13H28
10.92	93.86	1917518	Carbonic acid, ethyl 2-ethylhexyl ester	C11H22O3
11.17	95.72	11796364	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.56	90.48	1267641	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.83	91.95	2610240	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester	C12H24O3
12.12	95.23	1013088	Tetradecane	C14H30
12.57	96.28	1394927	Carbonic acid, isobutyl 2-ethylhexyl ester	C13H26O3
13.21	93.78	9740470	2,6-DI-T-BUTYL-4-METHYLENE-2,5-CYCLOHEXADIENE-1-ONE	C15H22O