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

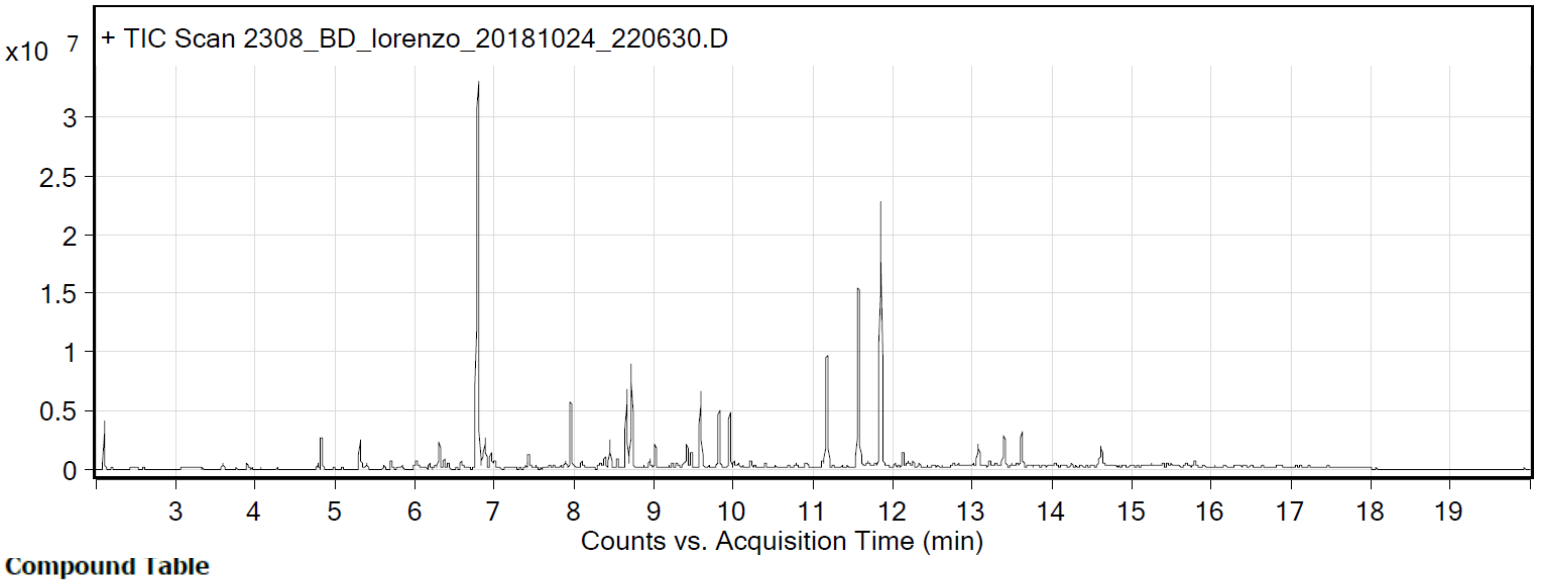
Halogenated compounds – can become reactive with exposure to heat and UV light

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

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

Sample: Baumann Dekor: Lorenzo 101 grey cotton fabric
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
1.51	97.95	877665	Acetic acid	C2H4O2
2.1	93.69	3485188	Silanediol, dimethyl-	C2H8O2Si
3.59	92.53	828188	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.89	95.49	841906	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
4.83	96.96	3616529	Ethanol, 2-butoxy-	C6H14O2
5.31	95.39	3543272	Ethanol, 2-(2-methoxyethoxy)-	C5H12O3
5.39	96.43	813057	2-Propanol, 1-butoxy-	C7H16O2
5.7	97.17	1044537	Benzaldehyde	C7H6O
6.03	92.4	1270159	Phenol	C6H6O
6.19	92.06	745585	Isooctanols	C8H18O
6.31	95.91	3173169	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.37	96.17	1088756	Octanal	C8H16O
6.41	96.02	825068	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.58	99.33	1308282	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.8	95.54	68774479	1-Hexanol, 2-ethyl-	C8H18O
6.88	91.11	2856568	Benzyl alcohol	C7H8O
6.89	94.25	1737926	(S)-3-Ethyl-4-methylpentanol	C8H18O
6.96	96.96	2564436	2-Pyrrolidinone, 1-methyl-	C5H9NO
7	92.86	805862	(S)-(+)-5-Methyl-1-heptanol	C8H18O
7.43	97.05	1845466	1-Octanol	C8H18O
7.96	97.94	8740462	Nonanal	C9H18O
8.39	91.02	1757749	1-Nonanol	C9H20O
8.45	97.48	3441460	Pentanedioic acid, dimethyl ester	C7H12O4
8.54	95.43	1187928	(S)-(+)-6-Methyl-1-octanol	C9H20O
8.66	95.58	9817269	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	94.36	13559272	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.95	97.07	1199076	1-Nonanol	C9H20O
9.02	97.98	3208802	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O

9.29	90.4	757076	Linalyl propionate	C13H22O2
9.42	95.25	3486958	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.47	96.35	2086566	Decanal	C10H20O
9.59	95.37	10042713	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.82	93.95	7410671	2-Ethylhexyl acrylate	C11H20O2
9.95	91.67	6769801	2-Ethyl-1-hexyl propionate	C11H22O2
10.22	88.24	1017202	2,3-Diethyl-2,3-dimethylsuccinonitrile	C10H16N2
10.4	93.19	784195	1-Decanol	C10H22O
10.79	90.61	715684	Decane	C10H22
11.12	88.21	901932	n-Butyric acid 2-ethylhexyl ester	C12H24O2
11.17	95.74	15453496	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.57	91.17	26353537	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.69	87.04	719905	Ethanol, 2-(2-butoxyethoxy)-, acetate	C10H20O4
11.85	93.55	40311258	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.13	94.61	1807887	Tetradecane	C14H30
12.77	87.23	692557	1-Tetradecanol	C14H30O
13.62	96.08	4090385	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.62	88.99	3179843	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4