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

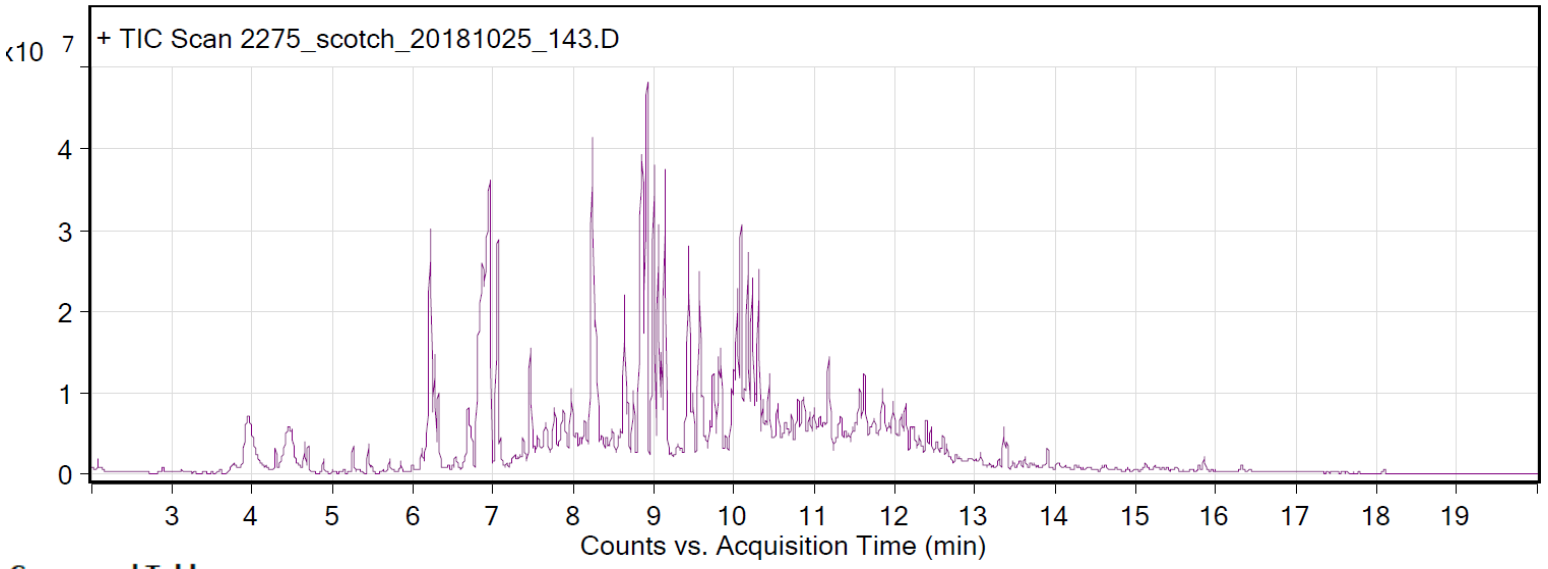
Halogenated compounds – can become reactive with exposure to heat and UV light

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

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

Sample: Scotch® Long Lasting Storage Packaging Tape, 3650-6
Oddy test result: Temporary
Date collected: 10/24/2018
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) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.51	97.95	4235914	Acetic acid	C2H4O2
2.08	94.77	1282766	Silanediol, dimethyl-	C2H8O2Si
3.78	96.32	6167783	Ethylbenzene	C8H10
3.94	91.71	51683247	unidentified C2-benzene	C8H10
4.17	94.57	2664293	Benzene, ethyl-	C8H10
4.29	98.48	4276776	unidentified C2-benzene	C8H10
4.38	90.92	10433145	Butane, 1,1'-oxybis-	C8H18O
4.45	98.37	34411528	unidentified C2-benzene	C8H10
4.49	90.02	2475620	n-Butyl ether	C8H18O
4.65	98.52	4852536	unidentified C2-benzene	C8H10
4.69	94.96	5775022	2-Propenoic acid, butyl ester	C7H12O2
4.89	96.07	2155249	Propanoic acid, butyl ester	C7H14O2
5.26	91.43	4858434	1-Pentanol, 3,4-dimethyl-	C7H16O
5.45	95.27	5605148	1-Hexanol, 4-methyl-, (S)-	C7H16O
5.71	97.23	2431852	Benzaldehyde	C7H6O
5.85	87.27	1917524	1-Heptanol	C7H16O
5.99	89.37	1394782	Pentane, 3,3-diethyl-	C9H20
6.11	91.39	4708611	1-Pentanol, 2-ethyl-4-methyl-	C8H18O
6.22	92.98	77571516	1-Heptanol, 6-methyl-	C8H18O
6.68	96.09	30165381	(s)-3-ethyl-4-methylpentanol-1	C8H18O
6.81	90.59	3066265	dl-Limonene	C10H16
6.92	85.24	52207632	4,5-dihydro-2-methyl-4-(1-methylethyl)oxazole	C7H13NO
7.06	95.69	60143902	(S)-(+)-5-Methyl-1-heptanol	C8H18O
7.46	96.86	31894087	1-Octanol	C8H18O
7.76	85.74	20789984	1-Hexanol, 3,5,5-trimethyl-	C9H20O
8.24	88.83	104161192	1-Heptanol, 6-methyl-	C8H18O
8.63	89.33	45094516	(S)-3-Ethyl-4-methylpentanol	C8H18O
8.75	94.8	13437654	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.06	87.93	52519595	Acetic acid, nonyl ester	C11H22O2

9.14	88.98	68658619	Acetic acid, octyl ester	C10H20O2
9.43	87.76	66831948	2-Propenoic acid, octyl ester	C11H20O2
9.57	92.59	45739485	Acetic acid, octyl ester	C10H20O2
10.08	87.34	55041847	2-Propenoic acid, octyl ester	C11H20O2
10.3	85.89	44282790	(S)-(+)-5-Methyl-1-heptanol	C8H18O
10.44	86.26	22573320	Propanoic acid, octyl ester	C11H22O2
10.71	88.95	10028400	acrylic acid octyl ester	C11H20O2
10.8	88.63	19892923	Tricosane	C23H48
11.16	85.14	9264886	Dodecane, 4,6-dimethyl-	C14H30
11.18	96.25	16016494	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.62	85.66	31754264	Cyclopropane, 1-methyl-1-(1-methylethyl)-2-nonyl-	C16H32
11.85	92.92	15326453	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.23	86.07	13892904	1-Hexadecanol	C16H34O
12.65	87.93	7383515	Cyclopropane, 1-methyl-1-(1-methylethyl)-2-nonyl-	C16H32
13.36	89.51	10327973	Hexadecane	C16H34
13.47	85.3	1564386	Dodecane, 4,6-dimethyl-	C14H30
13.9	88.52	5406564	Hexadecane	C16H34