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

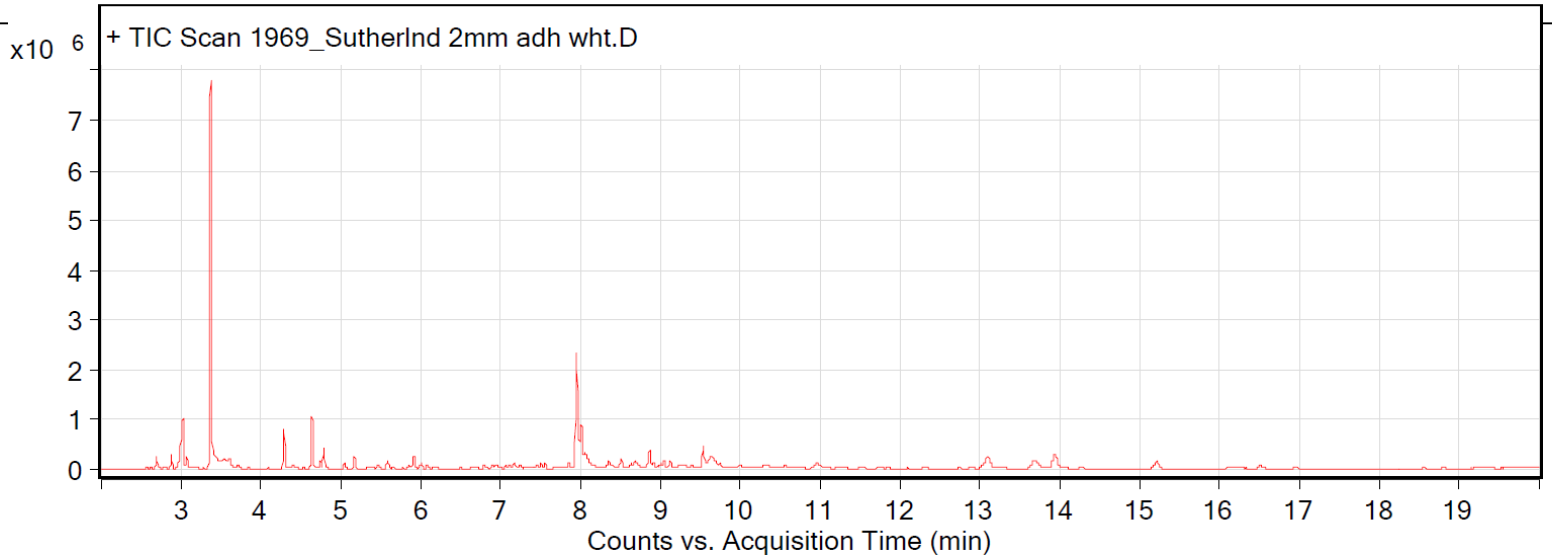
Sample: Sutherland Felt white polyester 2.0 mm with adhesive backing (removed for testing)

Oddy test result: unsuitable

Date collected: 12/23/2017

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



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.69	94.51	323420	2-Propanone	C3H6O
2.88	94.68	328749	Silanol, trimethyl-	C3H10OSi
3.02	98.25	2546017	Acetic acid	C2H4O2
3.07	95.41	377041	Acetic acid, ethyl ester	C4H8O2
3.37	95.1	11044798	1-Butanol	C4H10O
3.61	89.74	403719	Pentanal	C5H10O
4.29	93.52	1105033	Benzene, methyl-	C7H8
4.64	97.24	1571055	Hexanal	C6H12O
4.74	97.95	198322	Tetrachloroethylene	C2Cl4
4.79	93	555421	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.17	96.03	373949	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.58	95.91	327938	Benzene, 1,4-dimethyl-	C8H10
6.01	93.79	214160	Heptanal	C7H14O
6.07	95.97	155565	Ethanol, 2-butoxy-	C6H14O2
6.8	91.11	114739	Hexanal, 2-ethyl-	C8H16O
7.11	86.95	126101	Hexanoic acid	C6H12O2
7.17	95.27	163313	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.45	94.76	140981	unidentified C3-benzene	C9H12
7.51	93.69	143826	Decane	C10H22
7.55	95.67	167709	Octanal	C8H16O
7.85	90.74	176283	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
7.95	97.83	5305808	1-Hexanol, 2-ethyl-	C8H18O
8.01	95.48	1192110	dl-Limonene	C10H16
8.35	87.81	315815	Hexane, 2,2,5-trimethyl-	C9H20
8.5	89.32	296487	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
8.69	90.32	253570	Undecane, 4,8-dimethyl-	C13H28
8.87	93.14	494377	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
8.92	87.07	154905	Dichloroacetic acid, nonyl ester	C11H20Cl2O2
9.05	85.14	223782	Undecane, 2,8-dimethyl-	C13H28

9.12	95.63	187606	Nonanal	C9H18O
9.31	90.65	130517	1,1,1,2-tetrafluoro-2-tridecene	C13H22F4
9.53	87.57	596448	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.64	93.23	1251053	1-Hexanol, 2-ethyl-	C8H18O
13.94	92.61	1185367	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester	C12H24O3