

**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

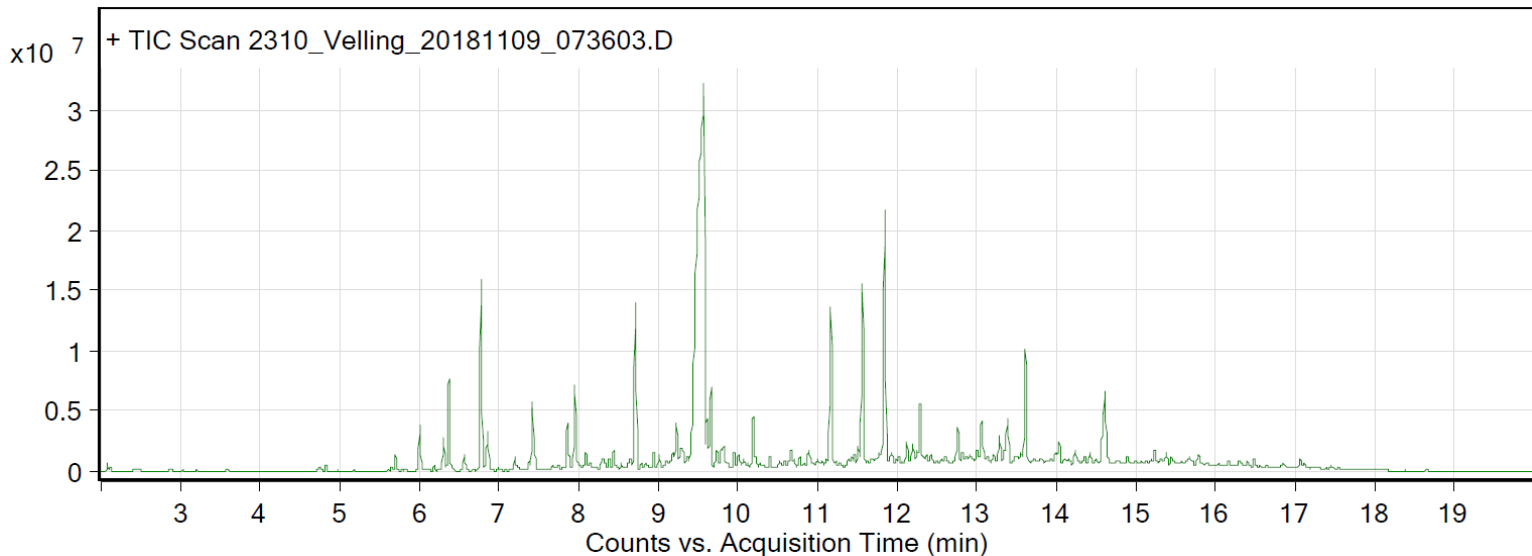
Sample: Creation Baumann: Velling III black fabric

Oddy test result: Unsuitable

Date collected: 11/9/2018

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: VOCs not highlighted are because they were also observed in blanks: (1) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



#### Compound Table

RT	Score (Lib)	Area	Name	Formula
1.51	97.95	2965046	Acetic acid	C2H4O2
5.7	97.64	1821020	Benzaldehyde	C7H6O
6	85.77	5103807	Phenol	C6H6O
6.3	95.93	3696431	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.37	97.52	10950895	Octanal	C8H16O
6.56	98.38	2348197	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
6.77	96.2	23670380	1-Hexanol, 2-ethyl-	C8H18O
6.84	87.22	2178564	EUCALYPTOL (1,8-CINEOLE)	C10H18O
6.86	96.21	3938189	Benzyl Alcohol	C7H8O
7.42	97.2	8537278	1-Octanol	C8H18O
7.86	94.25	6136608	tetrahydro linalool	C10H22O
7.95	97.09	11138015	Nonanal	C9H18O
8.38	90.67	1456482	Dichloroacetic acid, nonyl ester	C11H20Cl2O2
8.44	94.74	2335487	Pentanedioic acid, dimethyl ester	C7H12O4
8.65	92.69	1551610	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.71	95.44	21318027	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.94	89.93	2020436	Decyl heptyl ether	C17H36O
9.01	96.04	1815600	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./.-.)-	C10H20O
9.23	93.96	5991216	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
9.37	86.23	1437145	Dodecane	C12H26
9.48	85.06	2196514	Decanal	C10H20O
9.61	93.84	8036125	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.66	95.66	9890279	1,3-Dimethyl-2,4,5-trioxoimidazolidine	C5H6N2O3
9.82	90.19	3172639	2-Ethylhexyl acrylate	C11H20O2
9.95	90.08	1750104	2-Ethyl-1-hexyl propionate	C11H22O2
10.19	92.79	6264268	linalyl acetate	C12H20O2
10.4	96.99	1246597	1-Decanol	C10H22O

10.67	93.36	2478113	1-Undecanol	C11H24O
10.78	86.26	1221204	Tridecane	C13H28
11.17	96.18	21789743	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.46	93.34	1349315	1,3-Diacetin	C7H12O5
11.51	93.28	2927437	.ALPHA.-TERPINENYL ACETATE	C12H20O2
11.56	89.16	24930863	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.84	93.12	35817431	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.12	94.73	2880372	Tetradecane	C14H30
12.25	88.7	1615435	Dodecanal	C12H24O
12.76	88.09	5458454	1-Tetradecanol	C14H30O
12.92	86.36	2105754	Nonadecane	C19H40
13.29	93.84	3787453	1-Pentadecene	C15H30
13.61	97.84	13097613	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.03	93.05	2951670	n-Nonylcyclohexane	C15H30
14.42	86.44	1380817	Cyclopentane, 1,2-dimethyl-3-(1-methylethyl)-	C10H20
14.57	88.92	2723487	1,2-Benzenedicarboxylic acid, diethyl ester	C12H14O4
14.61	95.03	10988142	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4
15.23	89.89	2238199	Cyclohexadecane	C16H32
15.38	88.48	1519287	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
17.06	90.79	1326867	Isopropyl myristate	C17H34O2