

**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

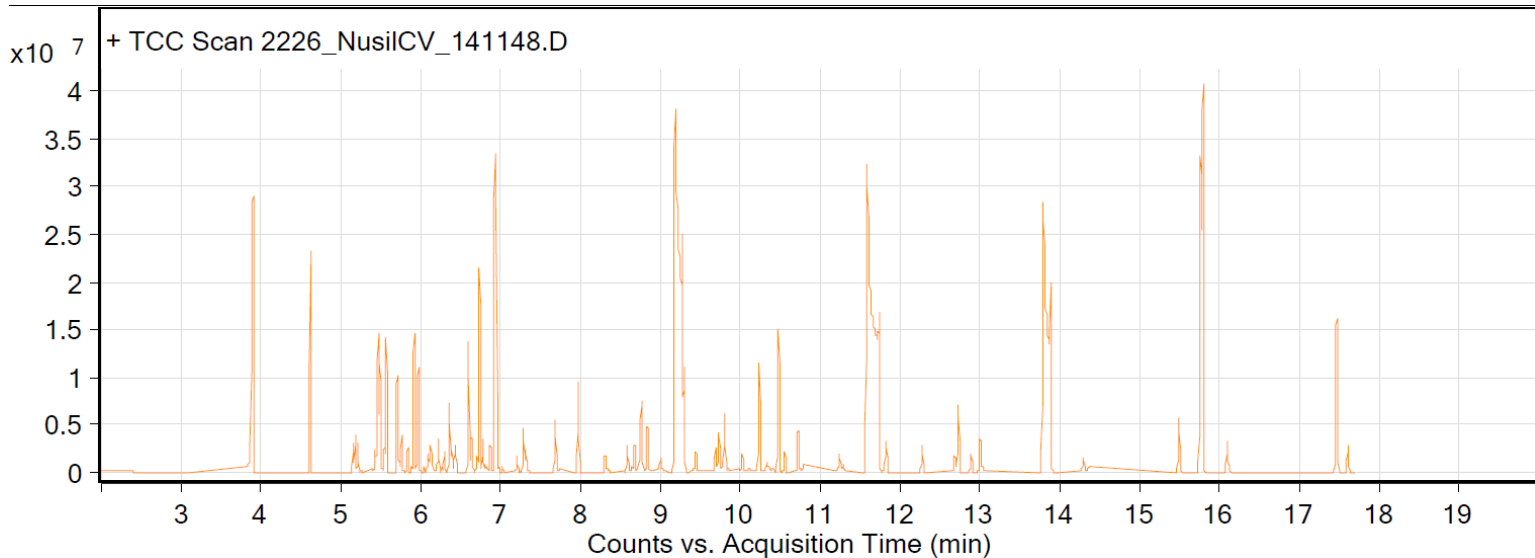
Sample: Nusil CV-2680-12 2-part film adhesive

Oddy test result: temporary

Date collected: 6/29/2018

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



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.9	92.93	2022000	Silanol, trimethyl-	C3H10OSi
5.15	91.16	2276536	Heptane, 3,5-dimethyl-	C9H20
5.18	89.25	2207338	Cyclohexane, 1,3,5-trimethyl-	C9H18
5.43	86.38	3388258	1-Undecene, 7-methyl-	C12H24
5.49	93.39	7075896	Octane, 2-methyl-	C9H20
5.57	93.9	7914685	Octane, 3-methyl-	C9H20
5.76	94.4	2452141	Cyclohexane, 1,2,4-trimethyl-	C9H18
5.84	94.84	2640926	Cyclohexane, 1-ethyl-4-methyl-, cis-	C9H18
5.92	96.41	15450029	Nonane	C9H20
5.97	96.8	13114405	Ethanol, 2-butoxy-	C6H14O2
6.09	87.42	2264000	Cyclohexane, 1-ethyl-4-methyl-, cis-	C9H18
6.12	88.82	3113496	Heptane, 2,4,6-trimethyl-	C10H22
6.22	94.42	4593986	Octane, 2,5-dimethyl-	C10H22
6.29	85.74	2640521	Octane, 3,5-dimethyl-	C10H22
6.36	94.78	3868357	Octane, 3,6-dimethyl-	C10H22
6.43	92.91	2173295	Octane, 3,6-dimethyl-	C10H22
6.59	94.36	8714415	BUTYLISOBUTYRATE	C8H16O2
6.63	87.56	3240697	Undecane, 5-methyl-	C12H26
6.7	93.46	2002869	Nonane, 5-methyl-	C10H22
6.73	94.95	3559124	Nonane, 4-methyl-	C10H22
6.78	89.96	3889864	Nonane, 2-methyl-	C10H22
6.87	95.55	3254339	Nonane, 3-methyl-	C10H22
6.93	92.73	65668956	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.21	95.99	2025630	Butanoic acid, butyl ester	C8H16O2
7.68	96.65	7411938	1-Hexanol, 2-ethyl-	C8H18O
7.97	93.33	11467882	Tetrasiloxane, decamethyl-	C10H30O3Si4
8.76	93.37	5750394	Undecane	C11H24
8.77	92.47	6087679	Silane, dimethylisobutoxybutoxy-	C10H24O2Si
8.84	96.1	6145234	Nonanal	C9H18O
9	88.02	2286190	1,1,1,2-tetrafluoro-2-tridecene	C13H22F4

9.18	95.96	168319941	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.44	95.6	3183461	Acetic acid, 2-ethylhexyl ester	C10H20O2
9.69	85.5	2115205	(S)-3-Ethyl-4-methylpentanol	C8H18O
9.8	97.7	8089662	1-Nonanol	C9H20O
10.02	94.43	2640887	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
10.23	95.47	15589776	Dodecane	C12H26
10.33	91.95	2085442	Decanal	C10H20O
10.47	97.72	20908587	Pentasiloxane, dodecamethyl-	C12H36O4Si5
11.24	95.88	2589061	1-Decanol	C10H22O
11.59	95.99	189128689	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
12.68	91.29	2421169	Propanoic acid, 2-methyl-, 3-hydroxy- 2,4,4-trimethylpentyl ester	C12H24O3
12.73	90.48	7691463	Hexasiloxane, tetradecamethyl-	C14H42O5Si6
13	95.54	5489384	Tetradecane	C14H30
15.76	88.64	75916115	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
17.46	85.76	25148434	Cyclononasiloxane, octadecamethyl-	C18H54O9Si9