

**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

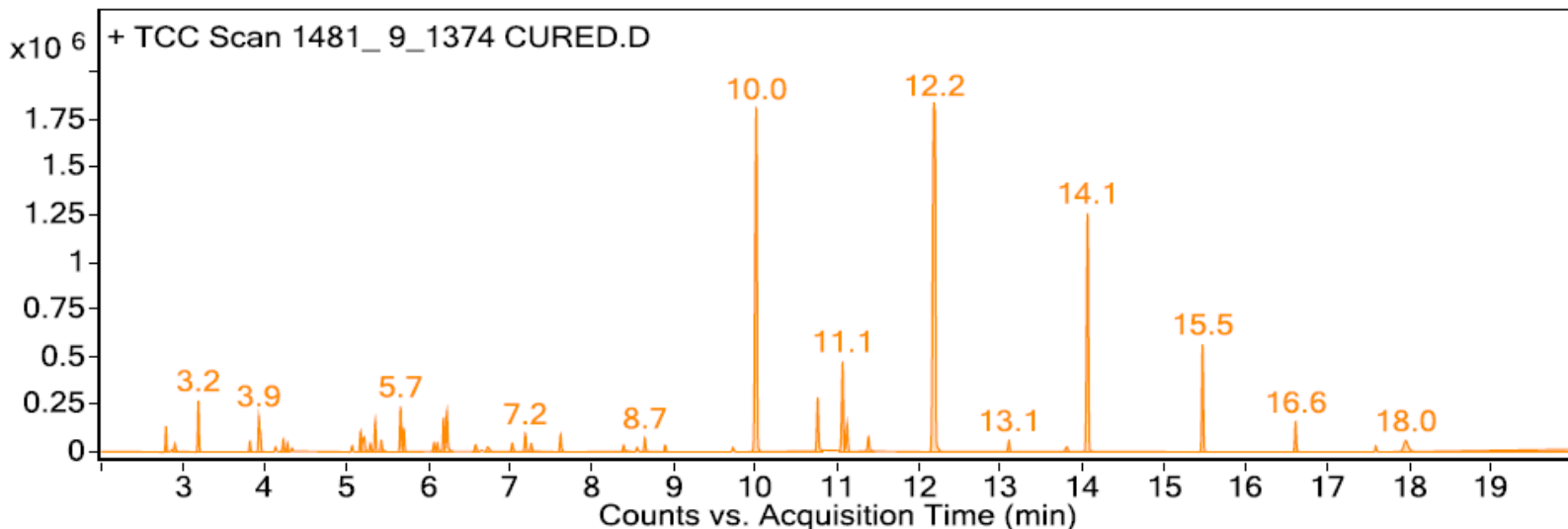
Sample: Dow Corning 9-1374 clear silicone sealant, cured 7 days

Oddy test result: Temporary

Date GC-MS collected: 8/31/2016

Technique used: SPME Arrow 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 sample at 60°C for 20 minutes; fiber exposure to sample at 60°C for 20 minutes; fiber injected into 220°C inlet and cryotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed in Masshunter Qualitative. Samples > 80% match with a NIST library are reported.

VOCs not highlighted are because they were also observed in blanks (1) 10.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 11.1 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



RT	Score	Formula	MW	Area	CAS #	Name
1.500	94.6	C3H6O	58.0	64226	67-64-1	2-Propanone
1.500	83.0	C4H10O	74.1	51056	78-92-2	2-Butanol
1.600	98.5	C4H10O	74.1	55772	75-65-0	2-Propanol, 2-methyl-
1.800	97.0	C4H8O	72.1	238948	78-93-3	2-Butanone
1.800	85.0	C3H8O	60.1	35718	999000-99-4	methylethyl ether
2.800	97.1	C7H8	92.1	124653	108-88-3	Benzene, methyl-
3.200	91.6	C6H18O3Si3	222.1	289130	541-05-9	Cyclotrisiloxane, hexamethyl-
3.800	95.4	C8H10	106.1	58938	0-00-0	METHYLLAURATE
3.900	98.3	C8H10	106.1	299550	1330-20-7	XYLENE
4.200	96.5	C8H10	106.1	79616	0-00-0	unidentified C2-benzene
4.300	97.4	C9H20	128.2	53985	111-84-2	Nonane
5.100	94.7	C9H12	120.1	37593	103-65-1	Benzene, propyl-
5.200	95.4	C9H12	120.1	132618	620-14-4	Benzene, 1-ethyl-3-methyl-
5.200	83.5	C10H10O3	178.1	67945	67519-26-0	1,4-[13C]-4-Oxo-4-phenylbutanoic acid

5.200	88.8	C9H12	120.1	80209	0-00-0	unidentified C3-benzene
5.300	89.6	C9H12	120.1	57490	526-73-8	Benzene, 1,2,3-trimethyl-
5.400	93.9	C8H24O4Si4	296.1	194032	556-67-2	Cyclotetrasiloxane, octamethyl-
5.400	83.6	C9H12	120.1	74947	0-00-0	C3 - benzene
5.700	95.3	C9H12	120.1	285947	0-00-0	unidentified C3-benzene
5.700	96.7	C10H22	142.2	139276	124-18-5	Decane
6.100	96.3	C9H12	120.1	54980	0-00-0	unidentified C3-benzene
6.200	98.9	C10H16	136.1	218929	138-86-3	dl-Limonene
6.200	97.2	C7H8O	108.1	151106	100-51-6	Benzenemethanol
7.200	91.7	C11H24	156.2	117310	1120-21-4	Undecane
7.300	89.9	C9H18O	142.1	51577	124-19-6	Nonanal
8.400	92.3	C10H20O	156.2	45405	1490-04-6	Cyclohexanol, 5-methyl-2-(1-methylethyl)-
8.600	95.4	C10H8	128.1	35257	2471-84-3	1H-Indene, 1-methylene-
8.700	94.3	C12H26	170.2	86835	112-40-3	DODECANE
8.900	81.2	C12H36O4Si5	384.1	45466	141-63-9	Pentasiloxane, dodecamethyl-
10.800	92.3	C12H24O3	216.2	397721	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.100	93.3	C12H24O3	216.2	680311	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
11.400	92.5	C14H30	198.2	108287	629-59-4	Tetradecane