

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

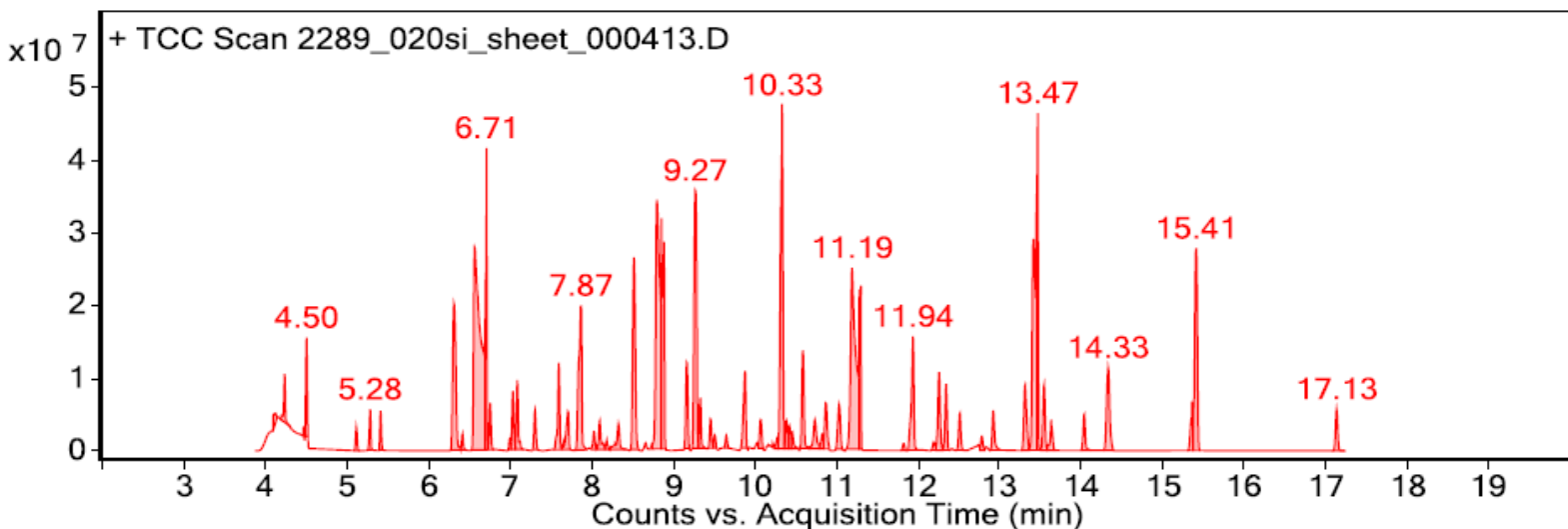
Sample: Acme rubber 0.020" silicone rubber sheet; black

Oddy test result: Permanent

Date collected: 08/18/2018

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 crotrapped 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) 5.3 min: methoxyphenyl oxime



Library results

RT	Score	Formula	MW	Area	CAS #	Name
4.070	90.0	C14H11NO	209.1	30667179	999205-14-4	(3R)-3-Phenyl-2,3-dihydro-1H-isindol-1-one
4.500	95.2	C6H18O3Si3	222.1	22316798	541-05-9	Cyclotrisiloxane, hexamethyl-
5.110	93.6	C8H24O2Si3	236.1	4235153	107-51-7	Trisiloxane, octamethyl-
5.280	84.9	C8H9NO2	151.1	7068330	1000222-86-6	Oxime-, methoxy-phenyl-
5.410	96.8	C6H14O2	118.1	6464743	111-76-2	Ethanol, 2-butoxy-
6.410	96.5	C9H10	118.1	3414748	98-83-9	.alpha.-Methylstyrene
6.560	93.3	C8H24O4Si4	296.1	168001305	556-67-2	Cyclotetrasiloxane, octamethyl-
6.710	84.8	C8H24O4Si4	296.1	14368525	556-67-2	Cyclotetrasiloxane, octamethyl-
6.750	96.7	C6H4Cl2	146.0	9585093	541-73-1	Benzene, 1,3-dichloro-
7.030	95.9	C8H18O	130.1	11293897	104-76-7	1-Hexanol, 2-ethyl-
7.090	97.2	C10H16	136.1	13882149	138-86-3	dl-Limonene
7.300	94.2	C10H30O3Si4	310.1	9103123	141-62-8	Tetrasiloxane, decamethyl-
7.570	93.2	C10H30O3Si4	310.1	3234321	141-62-8	Tetrasiloxane, decamethyl-
7.600	99.4	C8H8O	120.1	17243650	98-86-2	Ethanone, 1-phenyl-
7.710	87.6	C6H18O3Si3	222.1	11859061	541-05-9	Cyclotrisiloxane, hexamethyl-
7.840	95.1	C10H28O4Si3	296.1	16255818	3555-45-1	Silicic acid, diethyl bis(trimethylsilyl) ester

7.870	93.2	C9H12O	136.1	35600251	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.030	97.1	C11H24	156.2	4682253	1120-21-4	Undecane
8.100	81.2	C12H24	168.2	6839375	76441-79-7	4-Undecene, 7-methyl-
8.270	84.6	C13H28	184.2	1893320	17615-91-7	Undecane, 5,6-dimethyl-
8.520	92.3	C11H32O4Si4	340.1	58010642	18030-67-6	3-Ethoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy)trisiloxane
8.750	88.6	C11H20O2	184.1	1701672	103-11-7	2-Ethylhexyl acrylate
8.800	94.9	C10H30O5Si5	370.1	93767493	541-02-6	Cyclopentasiloxane, decamethyl-
8.890	94.6	C10H30O5Si5	370.1	45508191	541-02-6	Cyclopentasiloxane, decamethyl-
9.170	94.5	C10H30O5Si5	370.1	21543524	541-02-6	Cyclopentasiloxane, decamethyl-
9.270	97.3	C12H36O4Si5	384.1	80563998	141-63-9	Pentasiloxane, dodecamethyl-
9.330	95.0	C8H18O3	162.1	8752054	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
9.460	94.8	C12H26	170.2	7223097	112-40-3	Dodecane
9.650	92.3	C13H28	184.2	3974479	17301-23-4	Undecane, 2,6-dimethyl-
9.880	93.5	C8H24O4Si4	296.1	23284643	556-67-2	Cyclotetrasiloxane, octamethyl-
10.020	83.7	C12H24	168.2	2170021	4292-75-5	Cyclohexane, hexyl-
10.070	97.4	C12H36O4Si5	384.1	6781875	141-63-9	Pentasiloxane, dodecamethyl-
10.330	85.7	C10H30O5Si5	370.1	62307547	541-02-6	Cyclopentasiloxane, decamethyl-
10.460	92.2	C11H24	156.2	3752806	62016-34-6	Octane, 2,3,7-trimethyl-
10.710	87.0	C17H34	238.3	2296761	41977-41-7	Cyclopropane, 1-methyl-1-(2-methylpropyl)-2-nonyl-
10.830	89.0	C13H28	184.2	2227332	629-50-5	Tridecane
10.870	96.1	C12H36O6Si6	444.1	13393421	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.030	82.0	C10H30O5Si5	370.1	14649509	541-02-6	Cyclopentasiloxane, decamethyl-
11.220	82.6	C12H36O6Si6	444.1	65235137	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.300	81.1	C12H36O6Si6	444.1	18025004	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.940	89.7	C10H30O5Si5	370.1	30132689	541-02-6	Cyclopentasiloxane, decamethyl-
12.340	93.9	C14H42O5Si6	458.2	8498727	107-52-8	Hexasiloxane, tetradecamethyl-
12.920	94.2	C15H42O7Si5	474.2	10937566	1000074-06-9	3,3,5-Triethoxy-1,1,1,7,7,7-hexamethyl-5-(trimethylsilyloxy)tetrasiloxane
13.410	82.6	C14H42O7Si7	518.1	72845441	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.460	81.4	C8H14O2	142.1	5941690	999053-96-4	2-(1,1-Dimethylprop-2-en-1-yl)-1,3-dioxolane
15.410	89.2	C16H48O8Si8	592.2	62548679	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.130	84.6	C18H54O9Si9	666.2	10536078	556-71-8	Cyclononasiloxane, octadecamethyl-