

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

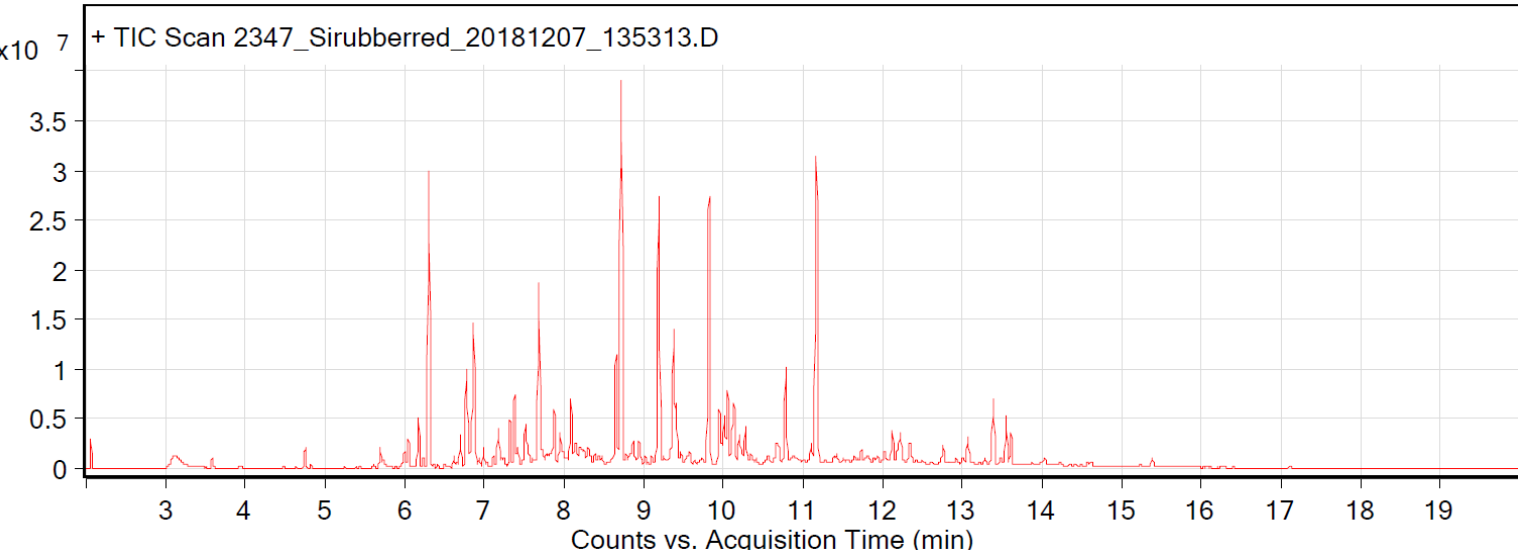
Sample: Stockwell Elastomerics: Norseal sponge silicone rubber, 0.032 R10470M Sil Sponge Plain

Oddy test result: Temporary

Date collected: 12/5/2018

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: (1) 11.5 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.71	94.03	889716	Benzene, methyl-	C7H8
2.06	93.64	2715906	Silanediol, dimethyl-	C2H8O2Si
3.11	91.65	10929742	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.58	91.73	1417829	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
4.75	85.08	3434004	Oxime-, methoxy-phenyl_	C8H9NO2
6.04	98.02	3957418	.alpha.-Methylstyrene	C9H10
6.17	88.65	7831879	1,1,1,2-tetrafluoro-2-tridecene	C13H22F4
6.3	96.09	43581409	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.61	93.38	1618699	4-Cyanocyclohexene	C7H9N
6.69	88.19	4654241	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
6.77	92.69	16908392	1-Hexanol, 2-ethyl-	C8H18O
6.86	95.56	14404790	Benzyl Alcohol	C7H8O
6.94	88.59	1290951	Undecane, 3,6-dimethyl-	C13H28
6.99	95.56	2713649	(S)-(+)-5-Methyl-1-heptanol	C8H18O
7.18	90.71	6866136	Octane, 2,6-dimethyl-	C10H22
7.32	90.7	7077070	Dodecane, 2,6,11-trimethyl-	C15H32
7.38	96.46	9721655	Ethanone, 1-phenyl-	C8H8O
7.41	91.68	747690	Tetrasiloxane, decamethyl-	C10H30O3Si4
7.42	88.63	2631592	2-Propyl-1-pentanol, chlorodifluoroacetate	C10H17ClF2O2
7.6	89.25	1439961	Undecane, 5-methyl-	C12H26
7.68	91.25	27743854	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
7.88	95.92	11621511	Undecane	C11H24
7.95	95.5	6401853	Nonanal	C9H18O
8.14	87.22	4069653	Dodecane, 2,6,11-trimethyl-	C15H32
8.19	88.87	3456503	1,1,1,2-tetrafluoro-2-tridecene	C13H22F4
8.3	92.79	4780925	Undecane, 4,7-dimethyl-	C13H28
8.38	89.86	2364075	Undecane, 2,8-dimethyl-	C13H28
8.65	96.14	18107492	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	96.39	70829701	Cyclopentasiloxane, decamethyl-	C10H30O5Si5

8.78	85.11	1873471	Octane, 6-ethyl-2-methyl-	C11H24
8.94	92.2	4220487	Undecane, 3-methyl-	C12H26
9.1	86.7	1406463	(S)-(+)-5-Methyl-1-heptanol	C8H18O
9.19	97.11	46304824	Pentasiloxane, dodecamethyl-	C12H36O4Si5
9.25	88.45	1614522	1-Dodecanol	C12H26O
9.37	90.49	23213689	Dodecane	C12H26
9.47	85.06	1915606	Decanal	C10H20O
9.58	85.49	2173044	Undecane, 5-ethyl-	C13H28
9.82	96.32	45082695	2-Ethylhexyl acrylate	C11H20O2
9.95	90.53	9166128	2-Ethyl-1-hexyl propionate	C11H22O2
9.97	86.95	1206766	1-Cyclobutylcyclopropanol	C7H12O
10.02	92.78	928625	Pentasiloxane, dodecamethyl-	C12H36O4Si5
10.05	87.93	11485705	2-Propenoic acid, octyl ester	C11H20O2
10.14	85.98	5535493	1-Heptanol, 3-methyl-	C8H18O
10.27	87.32	6144457	(S)-(+)-5-Methyl-1-heptanol	C8H18O
10.41	87.38	844242	Carbonic acid, bis(2-ethylhexyl) ester	C17H34O3
10.67	94.47	4292321	1-Tridecene	C13H26
10.78	95.04	14776242	Tridecane	C13H28
11.17	96.11	55200314	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.73	90.42	2409134	Tridecane, 3-methyl-	C14H30
12.01	92.98	1381347	1-Tetradecene	C14H28
12.12	94.86	5472330	Tetradecane	C14H30
12.32	91.88	728962	Hexasiloxane, tetradecamethyl-	C14H42O5Si6
12.34	92.62	3044614	2,4,7,9-Tetramethyl-5-decyne-4,7-diol	C14H26O2
12.76	88.08	3098367	1-Tetradecanol	C14H30O
13.07	90.22	4141195	2,6-di(t-butyl)-4-hydroxy-4-methyl-2,5-cyclohexadien-1-one	C15H24O2
13.28	91.93	1079643	1-Pentadecene	C15H30
13.48	93.16	1413991	bis(2-Ethylhexyl) ether	C16H34O
13.55	92.03	6185378	Phenol, 2,4-bis(1,1-dimethylethyl)-	C14H22O
13.61	97.34	4577802	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O