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

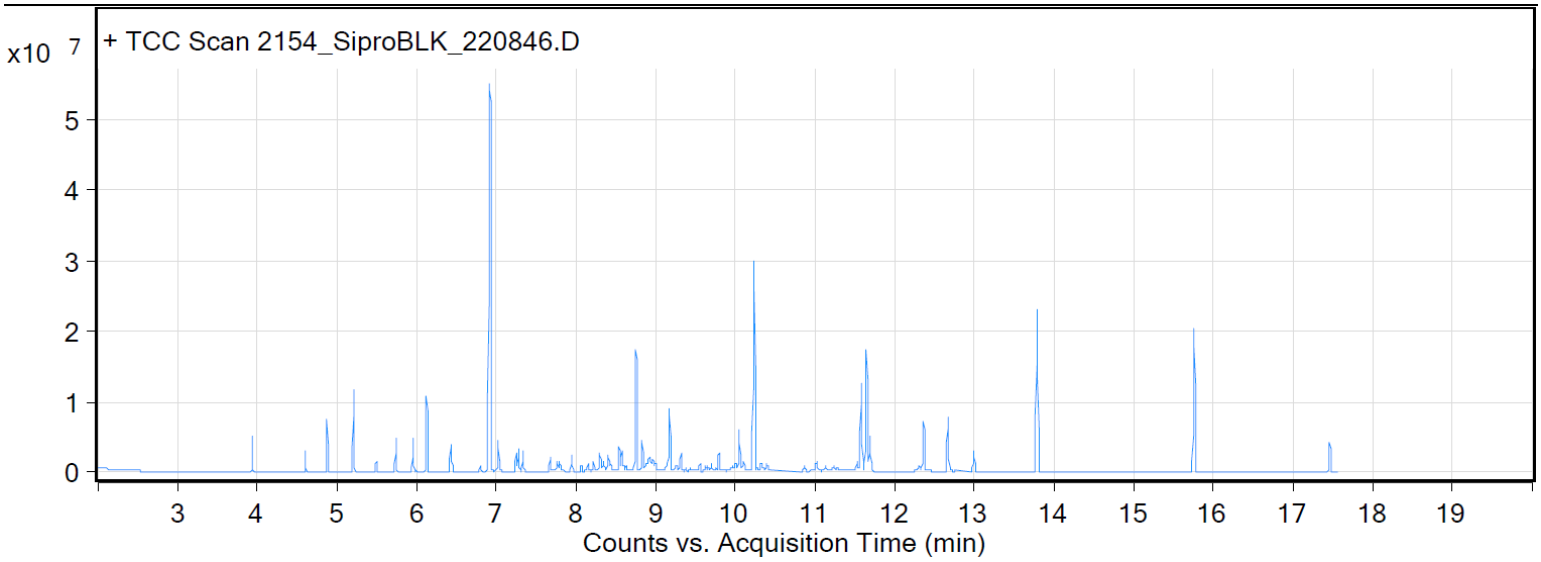
Sample: BSP silikone profile GmBH black silicone gasket

Oddy test result: temporary

Date collected: 4/30/2018

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) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid.



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.71	93.16	16129023	2-Propanone, 1-methoxy-	C4H8O2
3.93	93.67	3458665	Silanediol, dimethyl-	C2H8O2Si
4.88	92.42	6533944	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.21	95.67	11963566	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.49	92.64	1565992	Trisiloxane, octamethyl-	C8H24O2Si3
5.74	85.37	5323635	Oxime-, methoxy-phenyl-_	C8H9NO2
5.95	96.94	5188210	Ethanol, 2-butoxy-	C6H14O2
6.12	92.65	12506144	3-Methoxy-3-methylbutanol	C6H14O2
6.8	97.28	1208179	Benzaldehyde	C7H6O
6.92	93.49	109836593	Silicic acid (H4SiO4), tetraethyl ester	C8H20O4Si
6.93	87	8103484	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.02	86.57	4014685	Propanoic acid, 3-ethoxy-, ethyl ester	C7H14O3
7.25	95.39	3271503	unidentified C3-benzene	C9H12
7.28	96.76	3619323	Decane	C10H22
7.33	97.81	3285681	Octanal	C8H16O
7.67	97.49	2982675	1-Hexanol, 2-ethyl-	C8H18O
7.76	97.69	1694861	dl-Limonene	C10H16
8.22	93.69	1298575	Dodecane, 2,6,11-trimethyl-	C15H32
8.34	86.5	1175633	Octane, 2,4,6-trimethyl-	C11H24
8.54	93.11	5520841	2-Butoxyethyl acetate	C8H16O3
8.63	85.9	1291845	Cyclopentane, hexyl-	C11H22
8.76	96.63	23948838	Undecane	C11H24
8.83	94.57	6059846	Nonanal	C9H18O
8.92	88.67	2904357	Undecane, 2,10-dimethyl-	C13H28
9.14	89.94	2542782	Tricosane	C23H48
9.17	95.17	11177950	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.25	92.25	2014126	Decane, 2,3,7-trimethyl-	C13H28
9.62	88.98	1810700	Nonane, 5-(1-methylpropyl)-	C13H28
9.7	92.17	1659596	Undecane, 3,4-dimethyl-	C13H28

10	85.59	1227190	3-Undecene, 9-methyl-, (Z)-	C12H24
10.1	91.11	1417761	1-Dodecene	C12H24
10.23	96.25	44652681	Dodecane	C12H26
10.32	93.96	1900879	Decanal	C10H20O
11.02	93.95	2898257	Caprolactam	C6H11NO
11.24	91.87	1437639	Sulfurous acid, 2-ethylhexyl nonyl ester	C17H36O3S
11.53	95.16	2298096	1-Tridecene	C13H26
11.58	96.07	17565184	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	94.93	24789960	Tridecane	C13H28
11.69	96.16	3211539	2-Ethylhexyl methacrylate	C12H22O2
12.3	85.75	1581204	Heptylcyclohexane	C13H26
12.36	90.12	9781743	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	94.14	11068381	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.99	94.58	4310249	Tetradecane	C14H30
15.76	87.99	29913289	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8