

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

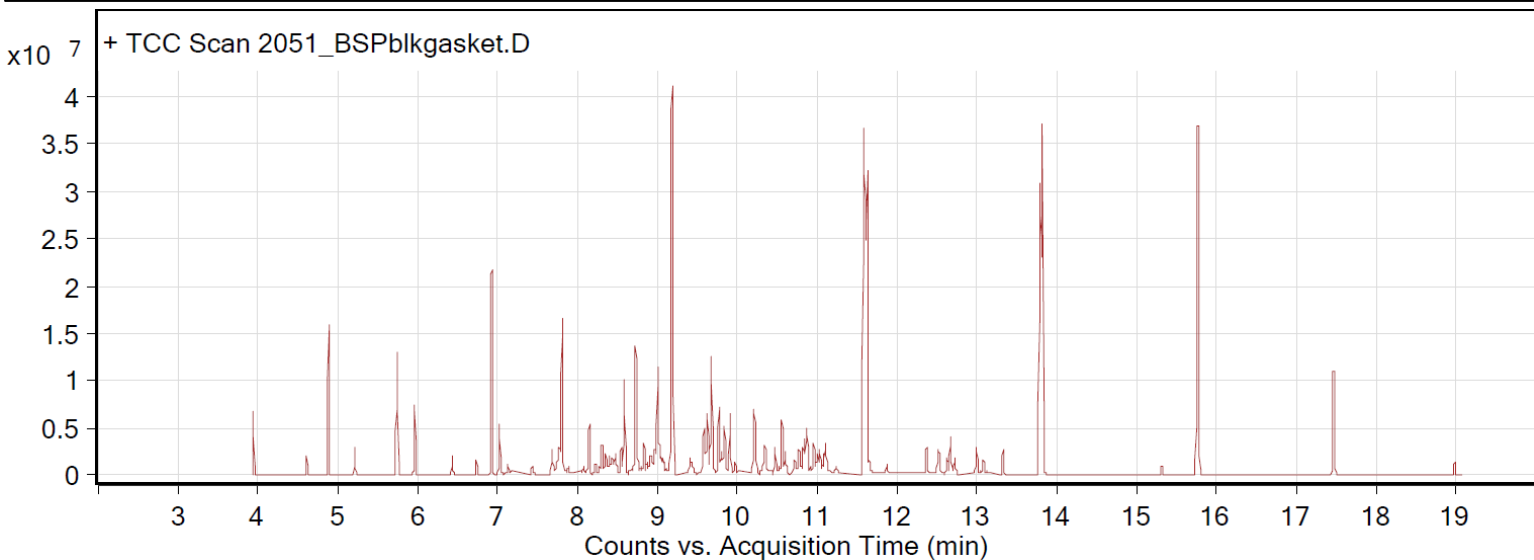
Sample: BSP silikon profile GmBH black silicone gasket

Oddy test result: temporary

Date collected: 3/17/2018

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
3.94	93.67	4653430	Silanediol, dimethyl-	C2H8O2Si
4.88	95.64	14287628	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.21	95.67	2746353	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.75	85.21	18343623	Oxime-, methoxy-phenyl-	C8H9NO2
5.96	96.92	8197798	Ethanol, 2-butoxy-	C6H14O2
6.43	96.37	2163202	2-Propanol, 1-butoxy-	C7H16O2
6.93	96.64	27944670	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.02	95.55	6092257	Propanoic acid, 3-ethoxy-, ethyl ester	C7H14O3
7.13	91.91	1337909	Isooctanol	C8H18O
7.43	90.95	1248276	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.68	94.65	4203726	1-Hexanol, 2-ethyl-	C8H18O
7.77	93.5	2511114	dl-Limonene	C10H16
7.78	90.83	3041577	Octyl ester of formic acid	C9H18O2
7.81	95.6	12560600	Benzyl Alcohol	C7H8O
7.89	95.33	1253402	(S)-(+)-5-Methyl-1-heptanol	C8H18O
8.14	88.56	6898826	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
8.35	86.38	2028150	Tetradecanal	C14H28O
8.4	85.31	1249366	2-Cyanocyclohexanol	C7H11NO
8.54	94.85	4043874	2-Butoxyethyl acetate	C8H16O3
8.73	97.14	16577841	Benzoic acid, methyl ester	C8H8O2
8.83	93.61	4677175	Nonanal	C9H18O
9	88.79	19010694	1-Heptanol, 6-methyl-	C8H18O
9.19	96.74	78643334	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.68	87	16878633	Acetic acid, octyl ester	C10H20O2
9.77	86.39	9216185	Acetic acid, octyl ester	C10H20O2
9.84	85.7	6411858	6-Methyloctyl acetate	C11H22O2
9.91	89.68	7154407	Acetic acid, 2-ethylhexyl ester	C10H20O2
9.97	96.14	1612517	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O

10.33	92.35	1162690	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
10.35	90.49	4964639	Acetic acid, octyl ester	C10H20O2
10.47	95.45	4027358	Pentasiloxane, dodecamethyl-	C12H36O4Si5
10.77	89.68	1920147	2-Propenoic acid, octyl ester	C11H20O2
10.96	85.67	4872825	2-Propenoic acid, octyl ester	C11H20O2
11.1	88.4	3378011	(S)-(+)-5-Methyl-1-heptanol	C8H18O
11.24	88.4	1166173	Decyl octyl ether	C18H38O
11.58	95.93	104863456	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	93.54	2499005	Tridecane	C13H28
11.87	85.06	1379490	Pentane, 2,2,3,4-tetramethyl-	C9H20
12.36	89.77	3937480	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	92.8	5377503	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.72	93.74	1418655	Hexasiloxane, tetradecamethyl-	C14H42O5Si6
13	94.94	4112347	Tetradecane	C14H30
13.08	95.62	2300716	2,4,7,9-Tetramethyl-5-decyne-4,7-diol	C14H26O2
15.76	88.59	69856306	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
17.46	85.18	16652743	Cyclononasiloxane, octadecamethyl-	C18H54O9Si9