

**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

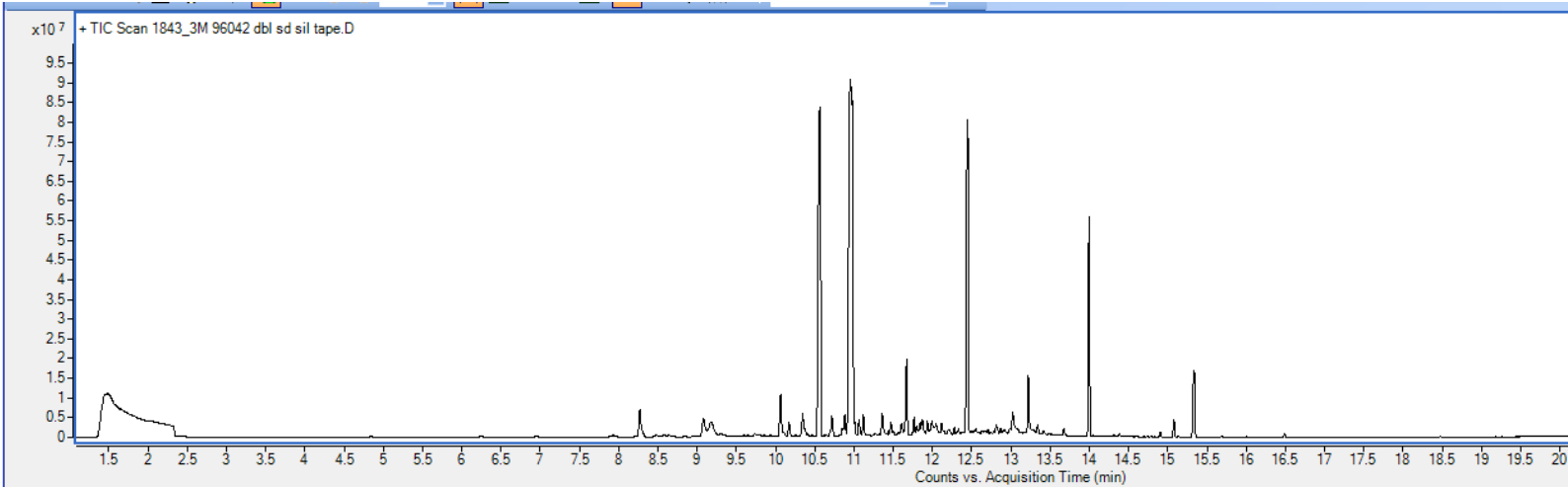
Sample: 3M 96042 double sided silicone liner adhesive

Oddy test result: Temporary

Date collected: 09/20/2017

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) 5.7 min: methoxyphenyl oxime; (2) 13.0 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (3) 13.2 min: 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.046	93.0	C3H10OSi	90.1	4807640	1066-40-6	Silanol, trimethyl-
7.928	98.6	C7H6O	106.0	1474336	100-52-7	Benzaldehyde
8.268	94.8	C8H24O4Si4	296.1	12120339	556-67-2	Cyclotetrasiloxane, octamethyl-
8.579	85.4	C10H22	142.2	1254751	124-18-5	Decane
9.085	80.5	C10H18O	154.1	9265346	21661-97-2	cis-7-Decen-1-al
9.169	97.2	C7H8O	108.1	6616638	100-51-6	Benzyl Alcohol
9.190	88.8	C9H18O2	158.1	6233054	999083-12-4	Octyl ester of formic acid
9.300	94.7	C8H18O	130.1	2813314	7212-53-5	5-Methyl-1-heptanol
9.732	81.9	C8H18O	130.1	1912795	111-87-5	1-Octanol
10.062	97.0	C8H8O2	136.1	16293186	93-58-3	Benzoic acid, methyl ester
10.104	94.3	C11H24	156.2	1773871	1120-21-4	Undecane
10.173	97.6	C9H18O	142.1	4600187	124-19-6	Nonanal
10.346	87.9	C8H18O	130.1	9902104	26952-21-6	Isooctanol
10.718	93.3	C10H20O2	172.1	6643250	103-09-3	Acetic acid, 2-ethylhexyl ester
10.882	80.7	C8H16O2	144.1	7122130	35897-13-3	3-Methylpentyl acetate
10.923	86.6	C10H20O2	172.1	10403296	112-14-1	Acetic acid, octyl ester
11.004	83.6	C10H20O2	172.1	6784710	112-14-1	Acetic acid, octyl ester
11.062	86.8	C11H22O2	186.2	5584501	1000439-66-5	6-Methyloctyl acetate
11.120	90.2	C10H20O2	172.1	6634449	103-09-3	Acetic acid, 2-ethylhexyl ester
11.361	88.5	C10H22O	158.2	8494565	106-21-8	1-Octanol, 3,7-dimethyl-
11.470	92.2	C10H20O2	172.1	5950962	103-09-3	Acetic acid, 2-ethylhexyl ester
11.608	88.8	C13H28	184.2	4948254	31081-17-1	Nonane, 2-methyl-5-propyl-
11.667	96.2	C11H20O2	184.1	22773555	103-11-7	2-Ethylhexyl acrylate
11.764	91.6	C11H22O2	186.2	6307733	999145-46-3	2-Ethyl-1-hexyl propionate
11.939	83.9	C11H20O2	184.1	5242787	2499-59-4	2-Propenoic acid, octyl ester
11.993	83.1	C13H28	184.2	6789991	62108-25-2	Decane, 2,6,7-trimethyl-
12.023	80.6	C14H14O	198.1	2179305	4237-44-9	Phenol, 2-(1-phenylethyl)-

12.118	87.8	C11H24	156.2	5926661	62016-28-8	Octane, 2,2,6-trimethyl-
12.206	89.9	C18H38O3S	334.3	3828555	999541-21-3	Sulfurous acid, decyl 2-ethylhexyl ester
12.274	90.7	C15H32	212.3	2481615	3891-98-3	Dodecane, 2,6,10-trimethyl-
12.331	89.1	C13H28	184.2	2979682	17301-30-3	Undecane, 3,8-dimethyl-
12.497	81.2	C13H28	184.2	1708372	17301-26-7	Undecane, 2,9-dimethyl-
12.553	84.0	C21H44O3S	376.3	4142433	999623-76-2	Sulfurous acid, butyl heptadecyl ester
12.674	82.5	C16H34	226.3	1984724	544-76-3	Hexadecane
12.707	80.1	C16H34	226.3	2549350	4390-04-9	Nonane, 2,2,4,4,6,8,8-heptamethyl-
12.780	81.3	C26H54	366.4	1297274	630-01-3	Hexacosane
12.813	89.9	C13H28	184.2	4207016	17312-75-3	Nonane, 5-methyl-5-propyl-
12.898	83.4	C13H28	184.2	1732517	17312-75-3	Nonane, 5-methyl-5-propyl-
13.022	88.4	C12H24O3	216.2	13966450	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
13.224	93.9	C12H24O3	216.2	22010297	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
13.419	94.3	C14H30	198.2	2786536	629-59-4	Tetradecane
13.676	97.0	C15H24	204.2	2161578	475-20-7	Longifolene
13.998	82.7	C14H42O7Si7	518.1	57247402	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.903	83.8	C18H52O7Si7	576.2	1199213	71579-69-6	3-Isopropoxy-1,1,1,7,7,7-hexamethyl-3,5,5-tris(trimethylsiloxy)tetrasiloxane
15.079	92.8	C16H30O4	286.2	2774690	74381-40-1	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester