

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

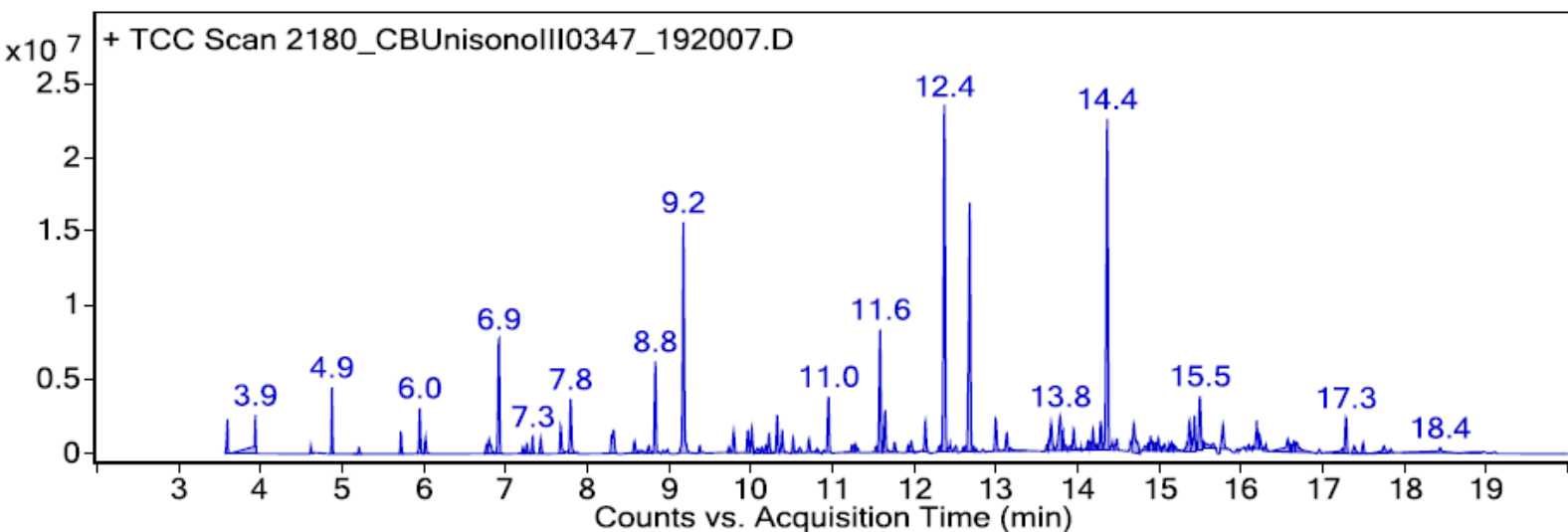
Sample: Creation Baumann Unisono III 0347 red fabric

Oddy test result: Temporary

Date collected: 05/31/2018

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) 5.7 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



Library results

RT	Score	Formula	MW	Area	CAS #	Name
3.600	98.6	C2H4O2	60.0	2325676	64-19-7	Acetic acid
3.900	81.0	C2H8O2Si	92.0	2299500	1066-42-8	Silanediol, dimethyl-
4.600	94.9	C4H10O2	90.1	480657	19132-06-0	2,3-Butanediol, [S-(R*,R*)]-
4.900	92.5	C6H18O3Si3	222.1	3771019	541-05-9	Cyclotrisiloxane, hexamethyl-
5.200	95.8	C6H12O2	116.1	438164	123-42-2	2-Pentanone, 4-hydroxy-4-methyl-
5.700	86.0	C8H9NO2	151.1	1477223	1000222-86-6	Oxime-, methoxy-phenyl-
6.000	97.0	C6H14O2	118.1	3314393	111-76-2	Ethanol, 2-butoxy-
6.000	93.8	C4H4O2	84.0	1306965	497-23-4	2(5H)-furanone
6.800	98.6	C7H6O	106.0	665097	100-52-7	Benzaldehyde
6.800	84.7	C6H12O2	116.1	831712	142-62-1	Hexanoic acid
6.900	91.9	C6H6O	94.0	1780800	108-95-2	Phenol
6.900	95.2	C8H24O4Si4	296.1	8702231	556-67-2	Cyclotetrasiloxane, octamethyl-
7.200	93.4	C7H16O3	148.1	534269	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.300	91.4	C7H16O3	148.1	895773	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.300	96.6	C8H16O	128.1	1006380	124-13-0	Octanal
7.400	97.6	C7H16O3	148.1	1434199	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.700	96.9	C8H18O	130.1	2481144	104-76-7	1-Hexanol, 2-ethyl-
7.800	96.1	C7H8O	108.1	4496975	100-51-6	Benzyl Alcohol
7.800	89.8	C6H14O2	118.1	433033	6920-22-5	1,2-Hexanediol
8.300	97.1	C7H8O	108.1	2339927	106-44-5	Phenol, 4-methyl-
8.700	83.9	C9H20O	144.2	385926	999057-76-9	2,6-dimethyl-1-heptanol
8.800	97.2	C9H18O	142.1	7686368	124-19-6	Nonanal
8.900	84.5	C6H6O3	126.0	393495	37112-31-5	Levoglucosenone
9.000	94.9	C8H10O	122.1	359158	60-12-8	Benzeneethanol
9.100	85.0	C9H20O	144.2	694445	143-08-8	1-Nonanol

9.200	95.4	C10H30O5Si5	370.1	20007620	541-02-6	Cyclopentasiloxane, decamethyl-
9.200	92.9	C9H20O	144.2	920489	143-08-8	1-Nonanol
9.400	96.0	C9H20O	144.2	688440	110453-78-6	(S)-(+)-6-Methyl-1-octanol
9.800	92.7	C9H20O	144.2	994078	143-08-8	1-Nonanol
10.000	98.1	C10H20O	156.2	2059857	15356-70-4	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./-./-)
10.000	95.1	C8H18O3	162.1	1193482	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.100	94.0	C10H8	128.1	490398	275-51-4	Azulene
10.200	96.9	C8H8O3	152.0	455813	119-36-8	Methyl salicylate
10.200	85.5	C12H26	170.2	1705860	112-40-3	Dodecane
10.300	91.8	C10H20O	156.2	3313790	112-31-2	Decanal
10.500	93.2	C8H10O2	138.1	1405365	122-99-6	Ethanol, 2-phenoxy-
10.700	80.2	C7H5NS	135.0	1351219	95-16-9	Benzothiazole
10.800	82.2	C10H22O3	190.2	406895	29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-
10.900	93.9	C9H12O2	152.1	384954	770-35-4	1-Phenoxypropan-2-ol
11.000	97.0	C12H24O2	200.2	4932289	7434-89-1	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester
11.200	96.4	C10H22O	158.2	752649	112-30-1	1-Decanol
11.300	87.5	C12H25I	296.1	378243	4292-19-7	Dodecane, 1-iodo-
11.600	95.7	C12H36O6Si6	444.1	11070502	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.600	95.3	C13H28	184.2	4114414	629-50-5	Tridecane
11.800	96.8	C11H22O	170.2	888909	112-44-7	Undecanal
12.000	90.0	C16H34	226.3	502117	4390-04-9	Nonane, 2,2,4,4,6,8,8-heptamethyl-
12.100	93.7	C9H14O6	218.1	1734626	102-76-1	Triacetin
12.400	89.7	C12H24O3	216.2	19054401	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.400	83.8	C10H20O4	204.1	533265	124-17-4	Ethanol, 2-(2-butoxyethoxy)-, acetate
12.700	93.8	C12H24O3	216.2	25017081	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.700	86.7	C14H42O5Si6	458.2	383748	107-52-8	Hexasiloxane, tetradecamethyl-
13.000	95.0	C14H30	198.2	3404034	629-59-4	Tetradecane
13.100	96.6	C12H24O	184.2	1748337	112-54-9	Dodecanal
13.700	90.8	C14H28	196.2	1630790	2882-98-6	Cyclopentane, nonyl-
13.800	88.6	C21H44	296.3	727834	54833-23-7	Eicosane, 10-methyl-
13.900	86.4	C14H20O2	220.1	335769	719-22-2	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-
14.000	96.5	C12H26O	186.2	2152214	112-53-8	1-Dodecanol
14.100	88.9	C13H28	184.2	1043328	17301-30-3	Undecane, 3,8-dimethyl-
14.200	95.4	C15H30	210.2	2025597	13360-61-7	1-Pentadecene
14.300	95.1	C15H32	212.3	2925980	629-62-9	pentadecane
14.400	94.6	C15H24O	220.2	33483809	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
14.400	91.0	C13H26O	198.2	517453	10486-19-8	Tridecanal
14.700	87.4	C16H48O6Si7	532.2	569060	541-01-5	Heptasiloxane, hexadecamethyl-
14.900	86.5	C20H42O3S	362.3	1094979	1000309-13-6	Sulfurous acid, hexyl tetradecyl ester
15.000	92.4	C15H30	210.2	1262360	2883-02-5	n-Nonylcyclohexane
15.100	84.6	C20H42	282.3	716409	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-
15.100	92.3	C16H34	226.3	742404	2882-96-4	Pentadecane, 3-methyl-
15.300	83.7	C12H24	168.2	367595	74630-67-4	5-Undecene, 3-methyl-, (E)-
15.500	90.4	C16H34	226.3	2616962	544-76-3	Hexadecane
15.800	90.5	C16H48O8Si8	592.2	783050	556-68-3	Cyclooctasiloxane, hexadecamethyl-
15.800	94.0	C15H30O2	242.2	2223845	10233-13-3	Dodecanoic acid, 1-methylethyl ester
15.900	90.8	C13H10O	182.1	345456	119-61-9	Benzophenone
16.000	86.7	C18H38	254.3	701297	3892-00-0	Pentadecane, 2,6,10-trimethyl-
16.100	86.1	C17H36	240.3	409678	1000360-41-2	3,3-Diethyltridecane
16.200	91.6	C16H32	224.3	1471140	295-65-8	Cyclohexadecane
16.200	89.6	C16H34O	242.3	1229202	629-82-3	Octane, 1,1'-oxybis-
16.300	85.8	C15H22O2	234.2	364044	999275-15-3	1-(4-ISOPROPYLPHENYL)-2-METHYLPROPYL ACETATE
16.600	92.0	C19H38	266.3	1431481	18435-45-5	1-Nonadecene
16.600	89.3	C17H36	240.3	1441202	629-78-7	Heptadecane
17.200	81.5	C16H33I	352.2	414711	544-77-4	Hexadecane, 1-iodo-
17.300	86.8	C16H16	208.1	3242567	20071-09-4	Benzene, 1,1'-(1,2-cyclobutanediyl)bis-, trans-
17.400	90.6	C17H34	238.3	484941	54105-66-7	Cyclohexane, undecyl-
17.500	98.0	C14H12O2	212.1	1123998	120-51-4	Benzyl benzoate
17.800	92.9	C15H22O3	250.2	401683	118-60-5	2-Ethylhexyl salicylate
18.400	88.6	C17H36O	256.3	419521	1454-85-9	1-Heptadecanol
19.000	81.4	C18H54O9Si9	666.2	638205	556-71-8	Cyclononasiloxane, octadecamethyl-
20.800	85.7	C27H42NP	411.3	338463	0-00-0	1,1'-bis(t-Butylimino)-1,1'-(1",1"-diethylpropyl)-3,3'-diphenyl-lambda(5),...
21.100	94.4	C16H10	202.1	837264	129-00-0	Pyrene