

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

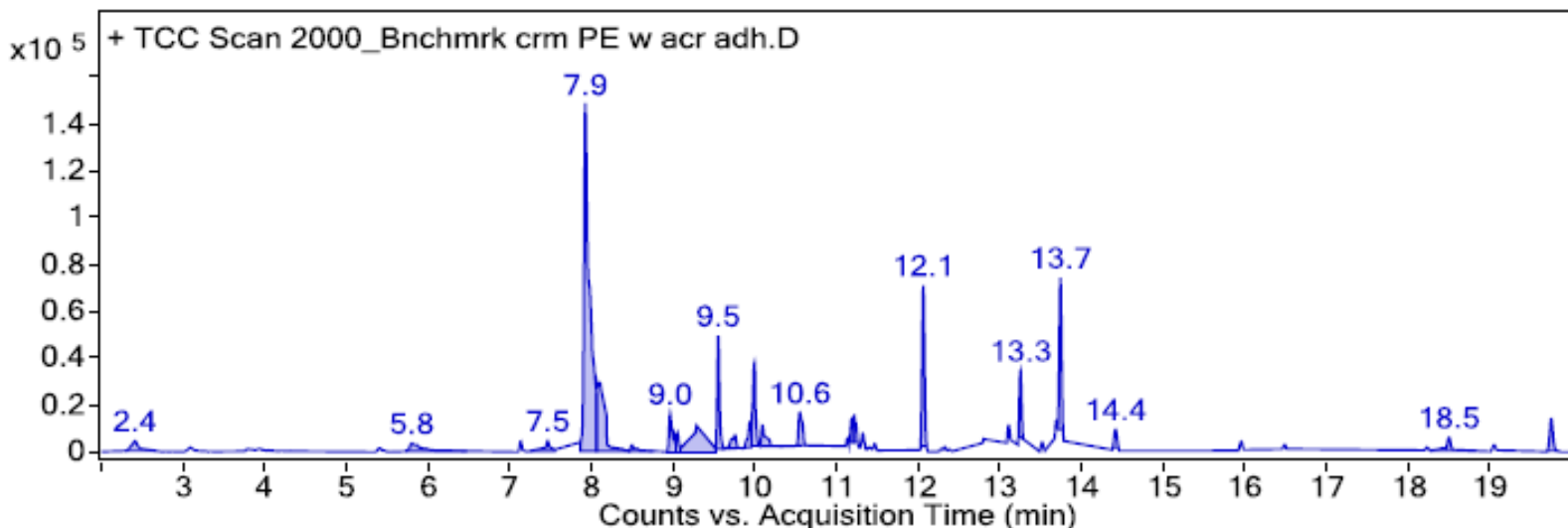
Alkynes – can become reactive when exposed to heat or UV light

Sample: Benchmark; Sueded polyethylene with acrylic adhesive backing, cream; 35-111CR

Oddy test result: Temporary

Date GC-MS collected: 12/22/2017

Technique used: SPME Arrow 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 sample at 60°C for 20 minutes; fiber exposure to sample at 60°C for 20 minutes; fiber injected into 220°C inlet and cryotrapped 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.



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.400	92.0	C2H4O2	60.0	26270	64-19-7	Acetic acid
5.400	87.1	C16H17NO	239.1	7000	999289-65-9	N,N-Dibenzyl-2-aminoethanal
7.100	91.8	C16H11NO2S	281.1	9322	999406-19-4	9-(Methylthio)-8H-acenaphtho[1,2-c]pyrrole-7-carboxylic Acid
7.500	85.3	C6H9F2IO	262.0	10064	999351-21-4	Iododifluoromethyl n-Butyl Ketone
7.900	96.3	C8H18O	130.1	692488	104-76-7	1-Hexanol, 2-ethyl-
8.000	83.0	C10H16	136.1	44850	138-86-3	dl-Limonene
8.100	84.3	C15H24O5	284.2	28244	83037-79-0	Methyl ester of 2S-(1,2,3,4,4a,5,6,7,8,8a.alpha.-Decahydro-1.alpha.,5.beta.-...
8.500	93.5	C12H14O3	206.1	7082	999196-00-9	t-Butyl benzoylformate
9.000	96.5	C8H8O2	136.1	46727	93-58-3	Benzoic acid, methyl ester
9.100	97.5	C10H20O2	172.1	12697	999113-32-8	Neopentyl 2,2-dimethylpropanoate
9.300	84.5	C9H16O	140.1	35443	18829-56-6	2-Nonenal, (E)-
9.600	86.8	C10H30O5Si5	370.1	102439	541-02-6	Cyclopentasiloxane, decamethyl-
9.800	88.3	C9H16O	140.1	19969	18829-56-6	2-Nonenal, (E)-
9.900	83.3	C10H20O	156.2	40635	999080-42-7	(R)-3-Methylnonen-4-ol
10.000	82.4	C12H24O2	200.2	69876	112-17-4	Acetic acid, decyl ester
10.100	96.7	C12H24O2	200.2	29265	112-17-4	Acetic acid, decyl ester
10.200	94.1	C17H26O4	294.2	11023	999441-70-6	5-Acetyl-Longipinandiолone
10.500	91.0	C12H26S	202.2	47244	999185-34-2	dihexylsulfide
11.200	90.6	C7H12O2	128.1	20841	999033-71-4	6-Heptanolide
11.300	90.5	C9H16O2	156.1	20438	2499-95-8	acrylic acid hexyl ester
11.500	91.8	C6H12O2	116.1	8419	999022-54-5	3-Ethyl-2-hydroxytetrahydrofuran
12.100	89.2	C12H36O6Si6	444.1	150367	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.300	83.0	C17H34O3	286.3	6990	114250-56-5	1-(dodecylcycloxy)-4-methoxybutan-2-one
13.100	99.3	C12H24O3	216.2	25790	999223-22-6	3-Hydroxy-2,2-dimethylhexyl ester of butanoic acid
13.300	88.0	C15H24	204.2	75793	1137-12-8	Longicyclene
13.700	91.8	C15H24	204.2	188168	475-20-7	Junipene
16.000	85.6	C14H24N4	248.2	11921	69856-67-3	3,3,5,5,3',3',5',5'-OCTAMETHYL-DI-(DELTA'-PYRAZOLINYLDENE)
18.500	86.9	C14H14O2	214.1	21664	104-66-5	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis-
19.700	91.8	C12H10O2S	218.0	41026	127-63-9	Benzene, 1,1'-sulfonylbis-