

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

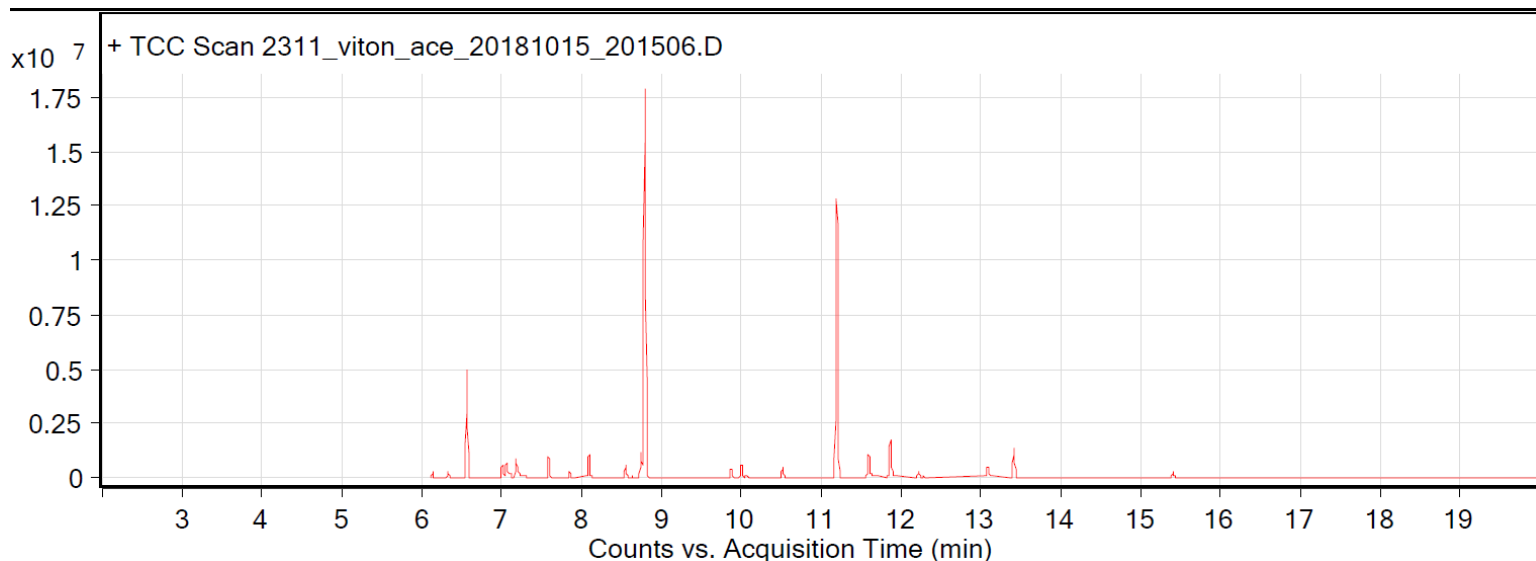
Alkynes – can become reactive when exposed to heat or UV light

Sample: Ace glass: Viton^(tm) o-ring

Oddy test result: temporary

Date collected: 10/15/2018

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.



Compound Table

RT	Score (Lib)	Area	Name	Formula
6.13	97.63	359858	Benzaldehyde	C7H6O
6.56	96.46	7253333	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.01	87.96	898239	1-Hexanol, 2-ethyl-	C8H18O
7.06	94.51	406178	D-Limonene	C10H16
7.07	92.41	520364	Butanedioic acid, dimethyl ester	C6H10O4
7.18	96.22	2065590	2-Pyrrolidinone, 1-methyl-	C5H9NO
7.59	97.22	1274043	Ethanone, 1-phenyl-	C8H8O
7.85	87.48	376006	.alpha.-Methylstyrene	C9H10
8.09	97.43	1473711	Nonanal	C9H18O
8.55	97.56	915508	Pentanedioic acid, dimethyl ester	C7H12O4
8.75	92.92	1585035	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.79	95.37	30810349	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.87	91.09	581944	2-Propenoic acid, 2-ethylhexyl ester	C11H20O2
10	92.31	905693	2-Ethyl-1-hexyl propionate	C11H22O2
10.51	91.45	781844	Benzaldehyde, 4-propyl-	C10H12O
11.2	96.22	22917882	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
12.22	93.92	511247	1,1'-Biphenyl, 2-methyl-	C13H12
13.09	86.2	889927	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-	C14H20O2
15.4	87.94	495403	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8