

**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

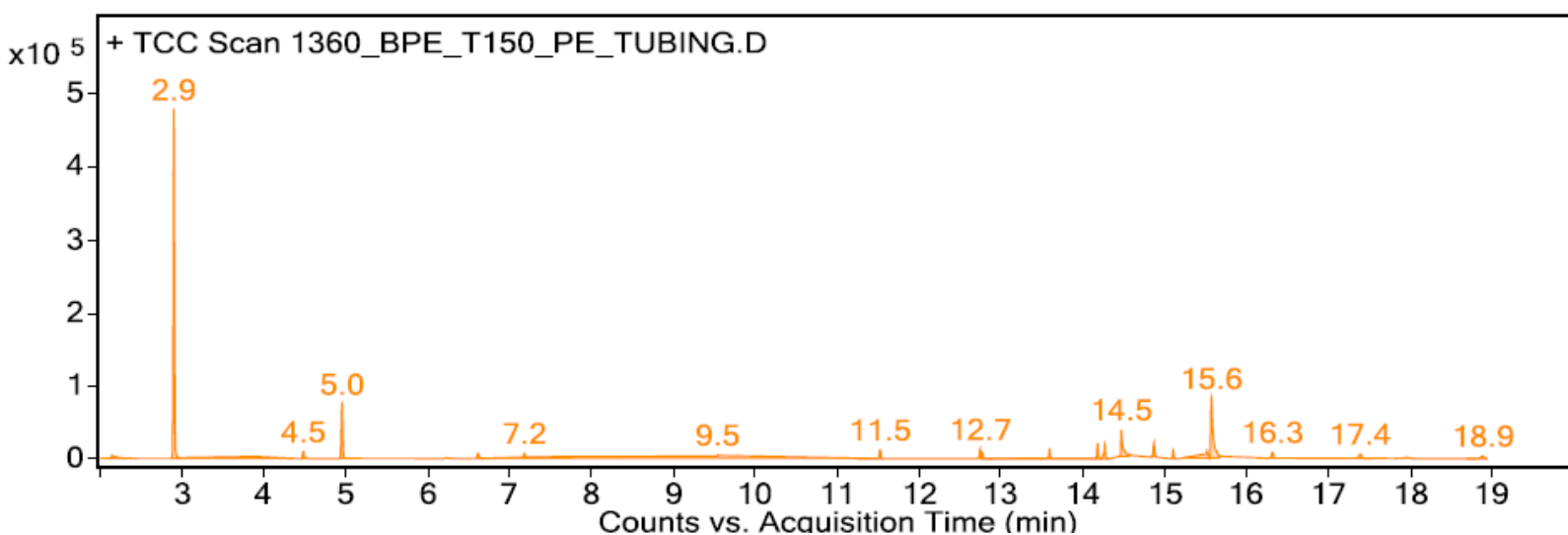
*Alkynes* – can become reactive when exposed to heat or UV light

Sample: Solomon Scientific BPE-T50 non-sterile polyethylene tubing, 0.023" ID x 0.038" OD

Oddy test result: Permanent

Date GC-MS collected: 2/26/2016

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
1.300	88.7	C2H4O	44.0	9003	75-21-8	Oxirane
1.400	96.1	C3H6O	58.0	152878	67-64-1	2-Propanone
1.600	94.0	C3H10OSi	90.1	65310	1066-40-6	Silanol, trimethyl-
1.800	93.5	C4H8O	72.1	12390	109-99-9	Furan, tetrahydro-
2.900	91.5	C6H18O3Si3	222.1	479961	541-05-9	Cyclotrisiloxane, hexamethyl-
3.900	83.5	C10H16O2	168.1	15674	999103-92-7	6-Methylhexahydrocycloprop[a]pentalen-3a,6-diol
4.500	83.3	C18H28O3Si	320.2	13243	999508-63-3	(S*,S*)-2-Hydroxy(4-methoxy-2-trimethylsilylphenyl)methyl-1-cycloheptanone
5.000	94.0	C8H24O4Si4	296.1	89066	556-67-2	Cyclotetrasiloxane, octamethyl-
6.600	82.4	C15H9NS2	267.0	12465	115172-83-3	[1]benzothieno[2,3-c]quinolin-6(5H)-thione
7.200	84.0	C15H26O4Si2	326.1	9463	55334-40-2	Benzeneacetic acid, .alpha.,4-bis[(trimethylsilyl)oxy]-, methyl ester
12.800	84.2	C17H26O2	262.2	7080	14035-34-8	2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol
14.200	92.0	C6H9F	100.1	18269	107557-15-3	trans-1-(Fluoromethyl)-2-vinylcyclopropane
14.500	85.7	C16H32O2	256.2	72500	57-10-3	Hexadecanoic acid
15.100	87.7	C6H9F	100.1	11788	107557-15-3	trans-1-(Fluoromethyl)-2-vinylcyclopropane
15.600	91.8	C15H16O2	228.1	170655	80-05-7	Phenol, 4,4'-(1-methylethylidene)bis-