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

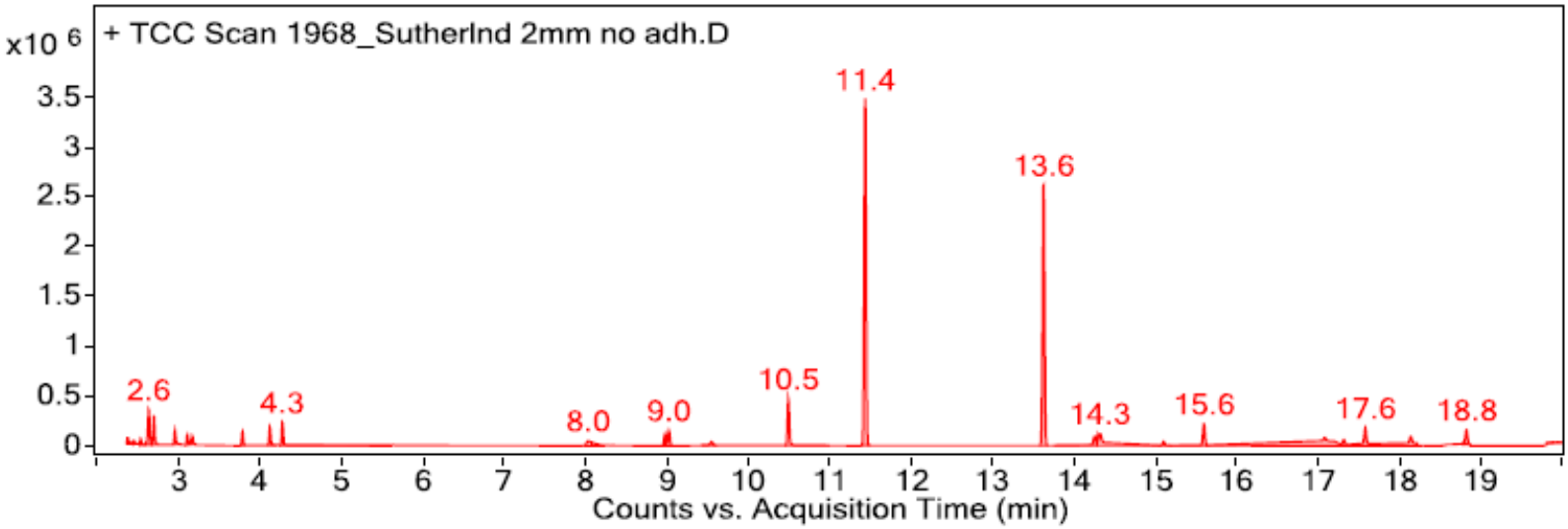
Alkynes – can become reactive when exposed to heat or UV light

Sample: Sutherland Felt Company; 2.0 mm polyester felt, white

Oddy test result: Temporary

Date GC-MS collected: 1/8/2018

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	91.7	C5H10O3	118.1	96172	110-49-6	Ethanol, 2-methoxy-, acetate
2.500	96.0	C2H3F	46.0	68646	75-02-5	Ethene, fluoro-
2.500	95.1	C3H10OSi	90.1	88032	1066-40-6	Silanol, trimethyl-
2.600	98.1	C2H4O2	60.0	537702	64-19-7	Acetic acid
2.700	95.6	C4H8O2	88.1	171007	141-78-6	Acetic acid, ethyl ester
3.000	86.9	C4H10O	74.1	204010	71-36-3	1-Butanol
3.100	94.8	C2H8O2Si	92.0	197046	1066-42-8	Silanediol, dimethyl-
3.200	92.1	C5H10O	86.1	85558	110-62-3	Pentanal
3.800	93.2	C7H8	92.1	177095	108-88-3	Benzene, methyl-
4.100	96.0	C6H12O	100.1	233199	66-25-1	Hexanal
4.300	95.9	C6H18O3Si3	222.1	337959	541-05-9	Cyclotrisiloxane, hexamethyl-
8.000	91.3	C8H16	112.1	69909	2511-91-3	Cyclopropane, pentyl-
8.100	97.2	C8H18O	130.1	137195	111-87-5	1-Octanol
9.000	88.5	C10H30O5Si5	370.1	186049	541-02-6	Cyclopentasiloxane, decamethyl-
9.000	89.7	C10H30O5Si5	370.1	255983	541-02-6	Cyclopentasiloxane, decamethyl-
9.600	96.3	C8H16O2	144.1	88743	124-07-2	Octanoic acid
10.500	94.8	C7H11NS	141.1	741608	1122-82-3	Cyclohexane, isothiocyanato-
11.400	91.8	C12H36O6Si6	444.1	5925854	540-97-6	Cyclohexasiloxane, dodecamethyl-
14.300	88.1	C13H28O4	248.2	179668	55934-93-5	Propanol, [(butoxymethylethoxy)methylethoxy]-
14.300	89.5	C13H28O4	248.2	354626	55934-93-5	Propanol, [(butoxymethylethoxy)methylethoxy]-
15.100	94.8	C12H14O4	222.1	67279	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
15.600	90.9	C16H48O8Si8	592.2	386491	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.300	80.0	C18H54O9Si9	666.2	149489	556-71-8	OCTADECAMETHYLCYCLONONASILOXANE
17.600	94.2	C14H14O2	214.1	438291	104-66-5	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis-
18.100	94.1	C16H22O4	278.2	191939	84-69-5	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
18.800	91.3	C12H10O2S	218.0	325473	127-63-9	Diphenyl sulfone
21.100	98.7	C16H10	202.1	148134	129-00-0	Pyrene