

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

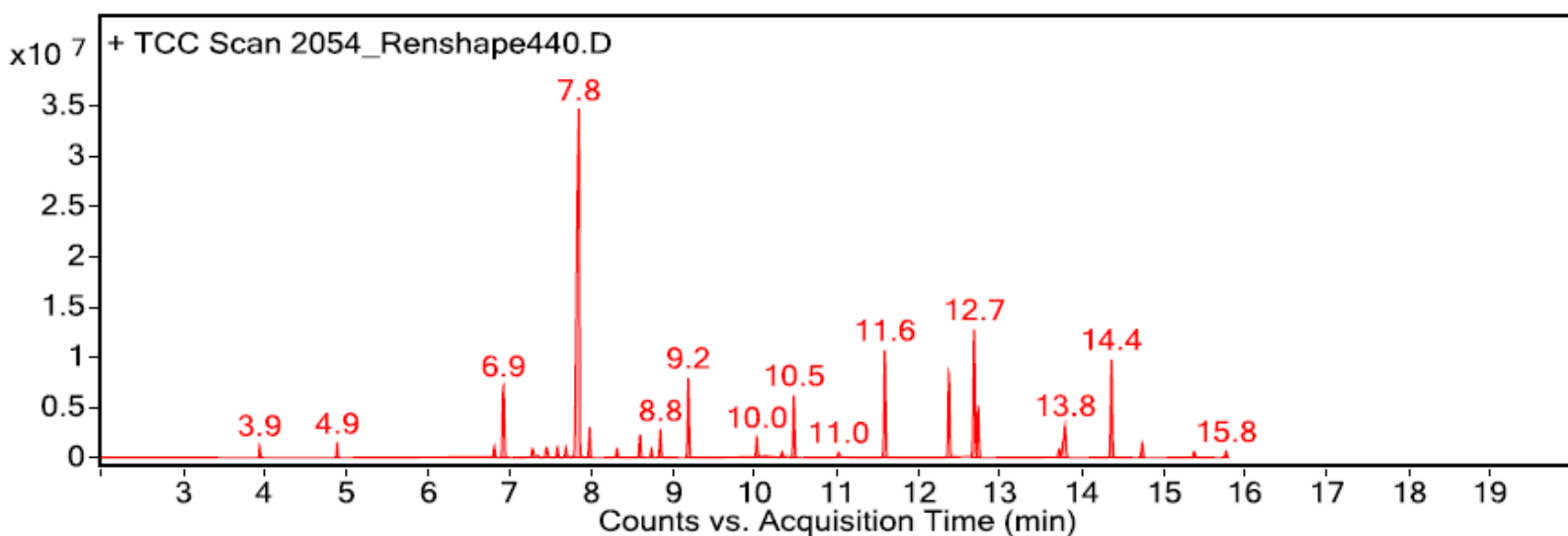
Sample: Renshape 440 foamed polyurethane board

Oddy test result: Permanent

Date GC-MS collected: 03/09/2018

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.

VOCs not highlighted are because they were also observed in blanks: (1) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.500	96.1	C4H10	58.1	959761	75-28-5	Propane, 2-methyl-
1.500	85.9	C3H7NO2	89.0	995432	108-03-2	Propane, 1-nitro-
3.900	95.1	C2H8O2Si	92.0	1001089	1066-42-8	Silanediol, dimethyl-
4.900	92.5	C6H18O3Si3	222.1	1350410	541-05-9	Cyclotrisiloxane, hexamethyl-
6.800	97.5	C7H6O	106.0	1351721	100-52-7	Benzaldehyde
6.900	92.1	C6H6O	94.0	7554941	108-95-2	Phenol
6.900	95.2	C8H24O4Si4	296.1	3623145	556-67-2	Cyclotetrasiloxane, octamethyl-
7.300	86.5	C7H16O3	148.1	1395074	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.400	94.9	C7H16O3	148.1	1755336	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.600	95.8	C6H4Cl2	146.0	1273258	541-73-1	Benzene, 1,3-dichloro-
7.700	93.9	C8H18O	130.1	1290034	104-76-7	1-Hexanol, 2-ethyl-
7.800	96.2	C7H8O	108.1	80589932	100-51-6	Benzyl Alcohol
8.000	94.5	C10H30O3Si4	310.1	3646243	141-62-8	Tetrasiloxane, decamethyl-
8.300	89.0	C8H8O	120.1	1179589	98-86-2	Ethanone, 1-phenyl-
8.600	90.9	C9H12O	136.1	2856952	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.700	97.2	C8H8O2	136.1	1000228	93-58-3	Benzoic acid, methyl ester
8.800	97.8	C9H18O	142.1	3363245	124-19-6	Nonanal
9.200	95.3	C10H30O5Si5	370.1	10128037	541-02-6	Cyclopentasiloxane, decamethyl-
10.000	95.6	C8H18O3	162.1	2748503	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.300	89.1	C10H20O	156.2	811874	112-31-2	Decanal
10.500	97.5	C12H36O4Si5	384.1	7970254	141-63-9	Pentasiloxane, dodecamethyl-
11.000	93.8	C6H11NO	113.1	847349	105-60-2	Caprolactam

11.600	96.0	C12H36O6Si6	444.1	14739868	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.400	90.1	C12H24O3	216.2	11792784	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.700	93.7	C12H24O3	216.2	17950844	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.700	92.7	C14H42O5Si6	458.2	5694025	107-52-8	Hexasiloxane, tetradecamethyl-
13.800	80.1	C15H24O2	236.2	1296053	10396-80-2	2,6-di(t-butyl)-4-hydroxy-4-methyl-2,5-cyclohexadien-1-one
13.800	80.7	C14H42O7Si7	518.1	4497289	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.400	96.7	C15H24O	220.2	13381577	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
14.700	87.8	C16H48O6Si7	532.2	2020324	541-01-5	Heptasiloxane, hexadecamethyl-
15.800	90.4	C16H48O8Si8	592.2	1028409	556-68-3	Cyclooctasiloxane, hexadecamethyl-