

## 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

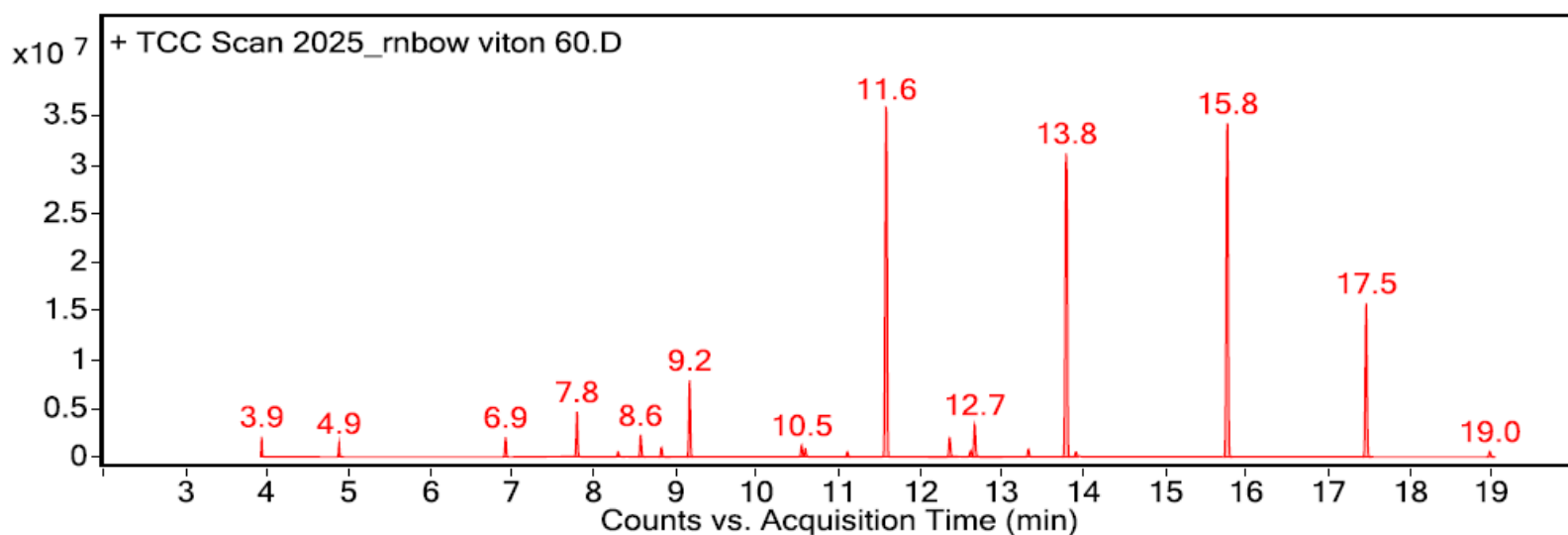
Sample: Rainbow Rubber black Viton 60 1/8" thick gasket

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
3.900	93.7	C2H8O2Si	92.0	1513114	1066-42-8	Silanediol, dimethyl-
4.900	92.5	C6H18O3Si3	222.1	1263800	541-05-9	Cyclotrisiloxane, hexamethyl-
6.900	94.6	C8H24O4Si4	296.1	2293228	556-67-2	Cyclotetrasiloxane, octamethyl-
7.800	96.3	C7H8O	108.1	5777239	100-51-6	Benzyl Alcohol
8.300	89.8	C8H8O	120.1	682073	98-86-2	Ethanone, 1-phenyl-
8.800	97.5	C9H18O	142.1	1159051	124-19-6	Nonanal
9.200	95.6	C10H30O5Si5	370.1	10294991	541-02-6	Cyclopentasiloxane, decamethyl-
10.600	94.2	C11H20O2	184.1	1055835	42928-87-0	4-(Prop-2-enoyloxy)octane
11.600	96.2	C12H36O6Si6	444.1	61861542	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.400	90.4	C12H24O3	216.2	2824796	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.700	93.1	C12H24O3	216.2	4579351	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.800	82.8	C14H42O7Si7	518.1	58302272	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.900	91.2	C14H22O2	222.2	720023	7534-94-3	iso-Bornyl methacrylate
15.800	88.4	C16H48O8Si8	592.2	58134932	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.500	86.5	C18H54O9Si9	666.2	23299914	556-71-8	Cyclononasiloxane, octadecamethyl-
19.000	80.3	C18H54O9Si9	666.2	850800	556-71-8	Cyclononasiloxane, octadecamethyl-