

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

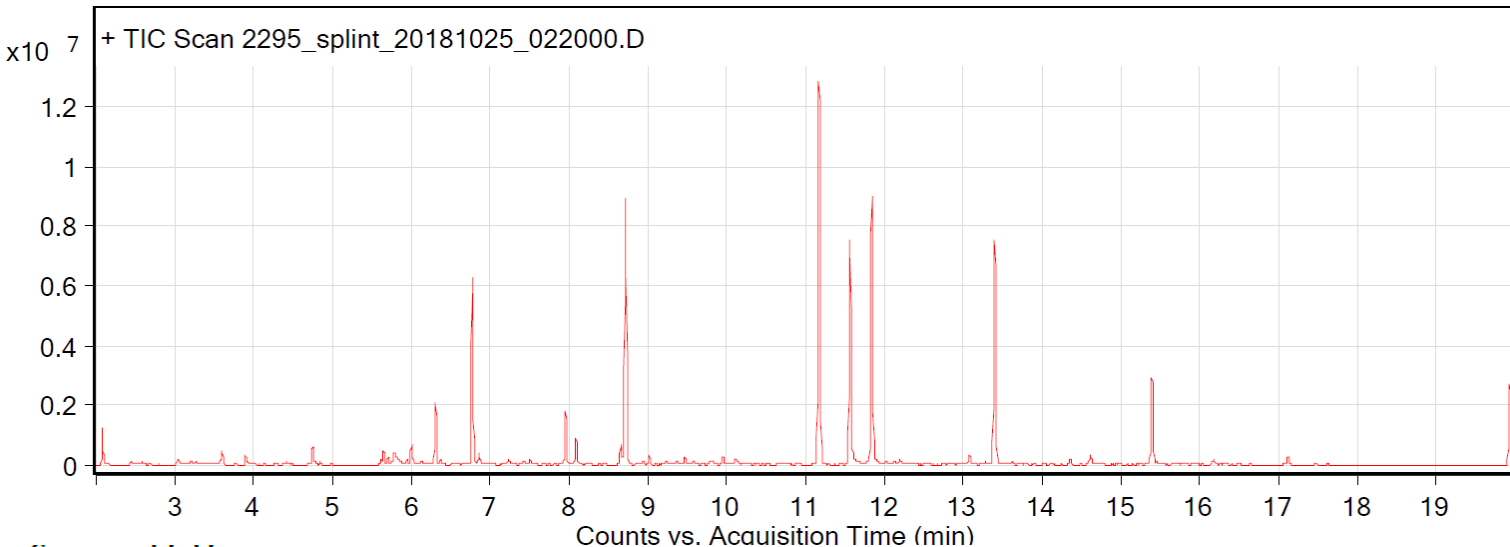
Sample: Keystone Industries: Pro-Form Splint Material, 9615000

Oddy test result: Temporary

Date collected: 10/23/2018

Technique used: SPME with a PDMS/Carbon WR 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.

VOCs not highlighted are because they were also observed in blanks: (1) 4.8 min: methoxyphenyl oxime; (2) 12.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (3) 12.8 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
1.5	97.94	1743866	Acetic acid	C2H4O2
1.73	86.73	212016	Hydrazine, (phenylmethyl)-	C7H10N2
2.08	93.71	1120447	Silanediol, dimethyl-	C2H8O2Si
3.6	92.49	679340	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.89	96.16	465654	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
4.75	85.56	709125	Oxime-, methoxy-phenyl-	C8H9NO2
5.71	97.86	332912	Benzaldehyde	C7H6O
5.95	94.42	371841	Hexanoic acid	C6H12O2
6.31	96.3	2775684	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.37	97.34	279558	Octanal	C8H16O
6.77	97.47	8524196	1-Hexanol, 2-ethyl-	C8H18O
6.8	94	531666	dl-Limonene	C10H16
6.86	94.48	517974	Benzyl Alcohol	C7H8O
7.23	87.15	270679	Nonane, 4,5-dimethyl-	C11H24
7.5	89.71	230232	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
7.96	97.9	2496896	Nonanal	C9H18O
8.65	96.25	965523	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.69	93.35	234205	2-methoxy[1]benzothieno[2,3-c]quinolin-6(5H)-one	C16H11NO2S
8.72	94.52	13453076	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.02	97.99	466763	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./-.)-	C10H20O
9.47	95.07	305331	Decanal	C10H20O
9.95	90.72	392693	2-Ethyl-1-hexyl propionate	C11H22O2
11.17	95.88	20326742	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.56	91.51	12454045	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.84	93.21	14377136	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.19	85.93	225852	Diphenylmethane	C13H12
14.35	88.69	246012	Heptasiloxane, hexadecamethyl-	C16H48O6Si7
14.62	92.02	576141	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester	C16H30O4
15.39	90.53	4566223	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8