

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

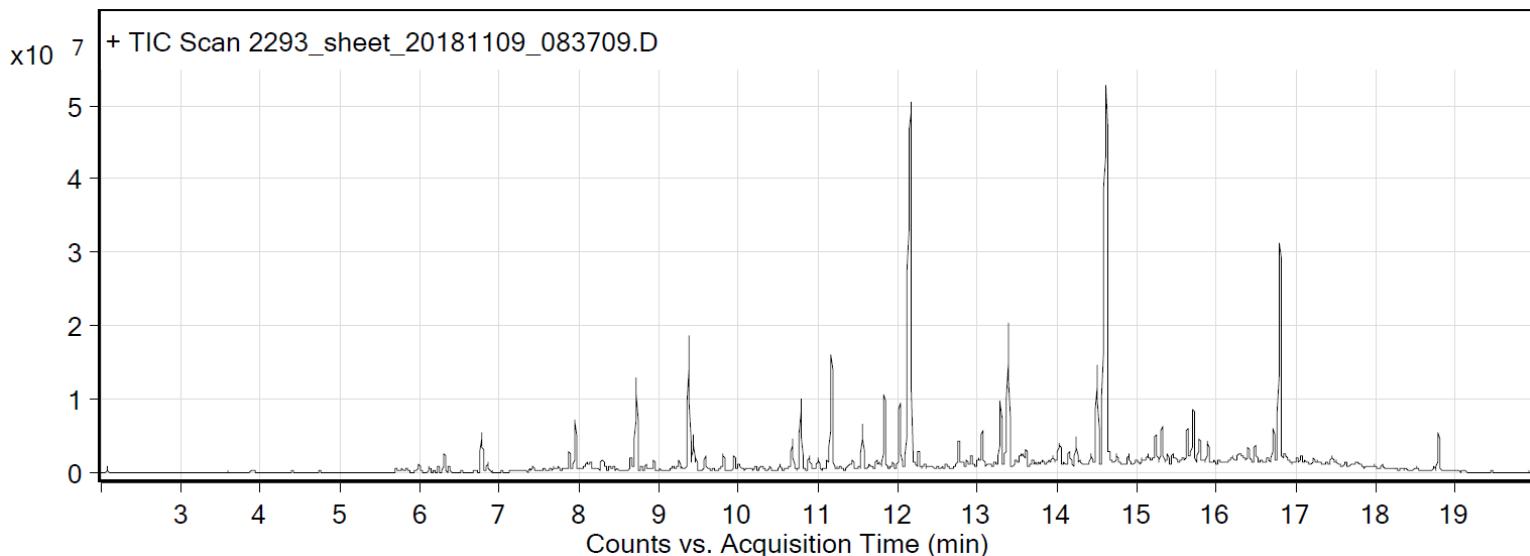
Sample: Zoro.com: Overspray Protective Sheeting, 3M No. 06728

Oddy test result: Temporary

Date collected: 11/9/2018

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) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
6.3	95.86	2645162	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.77	96.7	7394191	1-Hexanol, 2-ethyl-	C8H18O
6.79	94.59	4180402	dl-Limonene	C10H16
6.85	93.42	1844808	Benzyl Alcohol	C7H8O
7.88	96.63	4386968	Undecane	C11H24
7.95	97.26	10918886	Nonanal	C9H18O
8.28	96.81	1923180	Phosphoric acid, triethyl ester	C6H15O4P
8.3	90.01	2694755	Nonane, 4,5-dimethyl-	C11H24
8.65	96.99	3074420	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	95	19465636	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.94	93.94	1977711	9-methylheptadecane	C18H38
9.25	95.61	2865761	1-Dodecene	C12H24
9.38	95.27	29745101	Dodecane	C12H26
9.47	90.97	2139905	Decanal	C10H20O
9.58	86.81	3363582	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.81	95.81	3301965	2-Ethylhexyl acrylate	C11H20O2
9.95	87.03	2675040	2-Ethyl-1-hexyl propionate	C11H22O2
10.67	96.41	7083336	1-Tridecene	C13H26
10.79	95.03	15633157	Tridecane	C13H28
10.89	90.25	4007788	2-Hexyl-1-octanol	C14H30O
11	89.11	2977155	1-Octanol, 2-butyl-	C12H26O
11.17	96.61	26215281	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.56	88.75	10230976	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.83	93.74	16053472	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.02	96.13	16781905	1-Tetradecanol	C14H30O
12.16	87.13	118400704	Tetradecane	C14H30
12.26	97.57	3445312	Dodecanal	C12H24O
12.77	92.35	6919913	Cyclopentane, nonyl-	C14H28
12.93	88.22	3036796	Tetradecane, 2-methyl-	C15H32

13.29	96.01	15140265	1-Pentadecene	C15H30
13.53	87.83	1947004	Tridecanal	C13H26O
13.58	90.04	3246521	Tetradecane, 2,2-dimethyl-	C16H34
13.61	96.3	2949032	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.15	91.94	3651880	Pentadecane, 2-methyl-	C16H34
14.24	88.99	5297633	Pentadecane, 3-methyl-	C16H34
14.5	96.09	25803452	1-Hexadecanol	C16H34O
14.58	96.78	4471765	1,2-Benzenedicarboxylic acid, diethyl ester	C12H14O4
14.62	94.81	154638394	Nonadecane	C19H40
14.75	95.05	2824939	Tetradecanal	C14H28O
14.9	93.32	2521779	Dodecanoic acid, 1-methylethyl ester	C15H30O2
15.24	91.51	7359162	Cyclohexadecane	C16H32
15.32	94.34	8856764	Octane, 1,1'-oxybis-	C16H34O
15.63	95.81	9267636	1-Nonadecene	C19H38
15.71	95.7	12237482	Heptadecane	C17H36
15.78	87.3	3563675	Pentadecane, 2,6,10,14-tetramethyl-	C19H40
16.2	85.86	2341707	Heptadecane, 7-methyl-	C18H38
16.39	86.67	3270234	Cyclohexane, undecyl-	C17H34
16.72	95.98	8073390	1-Octadecanol	C18H38O
16.8	93.51	55762035	Octadecane	C18H38
17.75	88.5	1584225	1-Nonadecene	C19H38
18.79	93.44	8426864	Eicosane	C20H42