

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

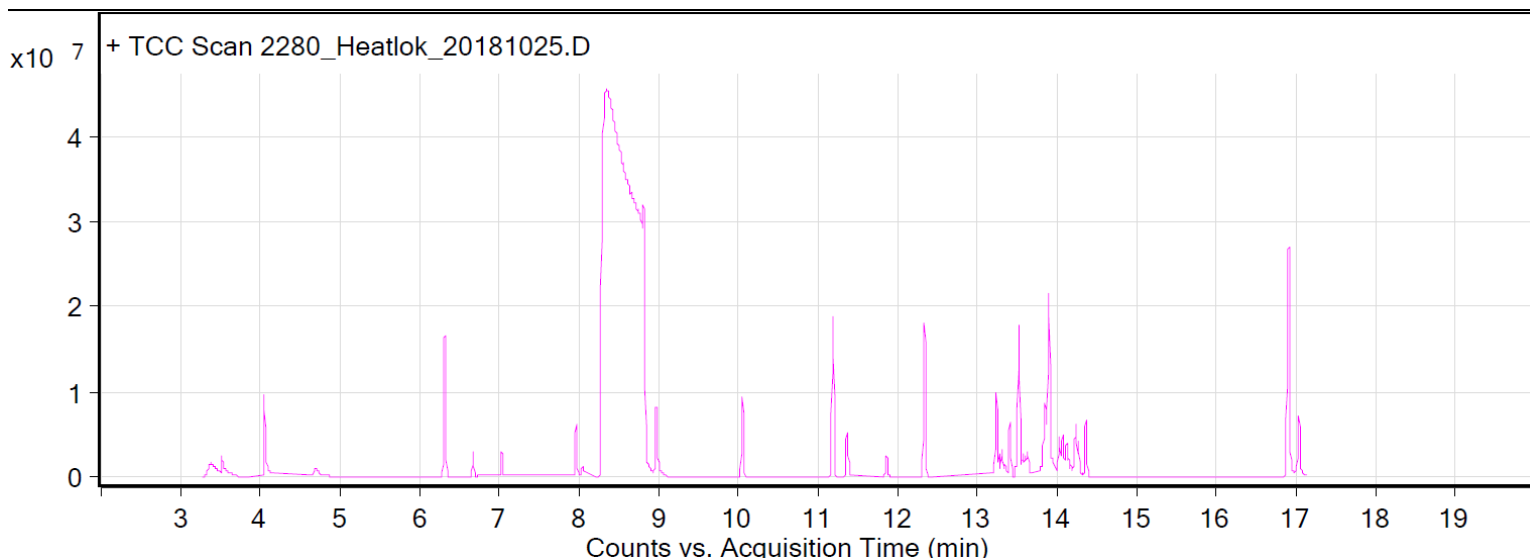
Sample: Airseal Insulation Systems: Heatlok XT 3" thick expanded green urethane foam

Oddy test result: unsuitable

Date collected: 10/25/2018

Technique used: SPME 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 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) 11.9 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.38	87.48	15169080	Benzene, chloro-	C6H5Cl
3.51	93.92	5184619	1,2-Ethanediamine, N,N,N',N'-tetramethyl-	C6H16N2
4.05	96.22	13998279	Piperazine, 1,4-dimethyl-	C6H14N2
6.31	97.75	29576787	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.96	97.72	9205667	Nonanal	C9H18O
8.33	86.37	235698855	N-But-3-enyl-N-butylformamide	C9H17NO
8.82	95.48	35444086	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.97	91.96	14439102	1,2-Ethanediamine, N-[2-(dimethylamino)ethyl]-N,N',N'-trimethyl-	C9H23N3
10.05	97.39	16649856	Pentasiloxane, dodecamethyl-	C12H36O4Si5
11.19	96.15	35356197	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.86	93.56	4190856	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.33	95.85	32646020	Hexasiloxane, tetradecamethyl-	C14H42O5Si6
14.36	88.35	12033291	Heptasiloxane, hexadecamethyl-	C16H48O6Si7
16.91	95.17	59145474	2-Propanol, 1-chloro-, phosphate (3:1)	C9H18Cl3O4P
17.04	91.78	14366654	1ST PEAK IN FYROL PCF	C9H14Cl4O4