

**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

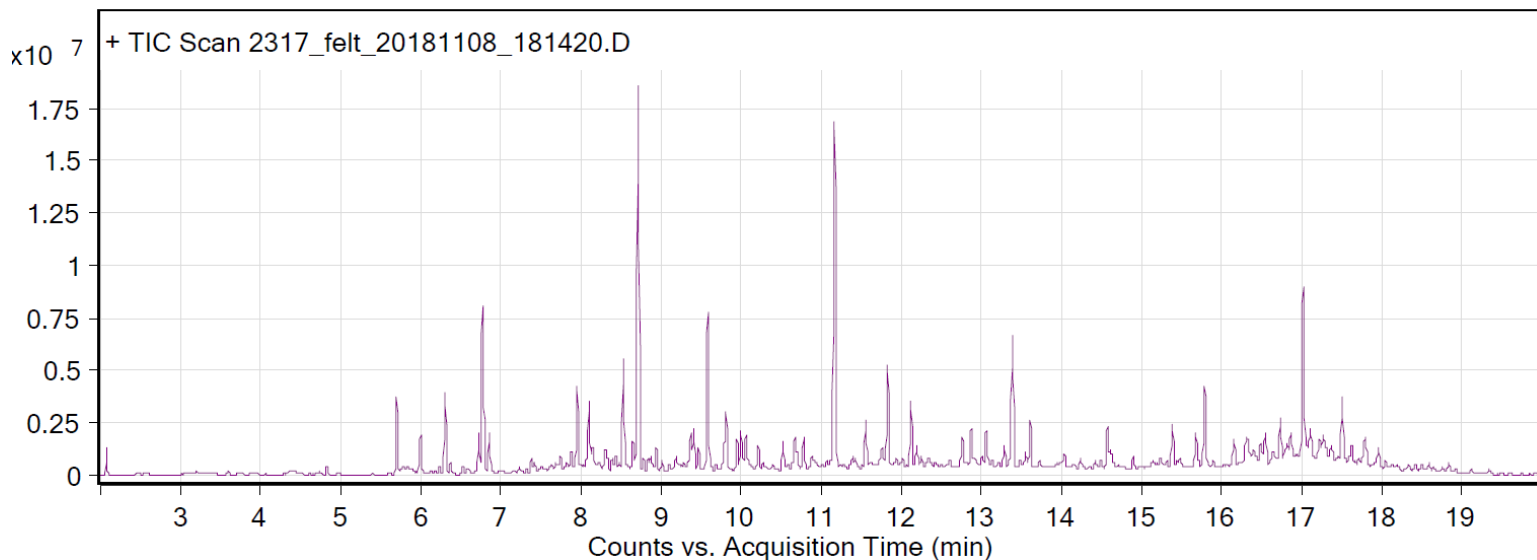
Sample: Sutherland Felt Company: 1/4" Stif-Felt w/ 8950 PSA, PE-F-59230-48

Oddly test result: Temporary

Date collected: 11/8/2018

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: 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;



**Compound Table**

RT	Score (Lib)	Area	Name	Formula
1.69	92.08	693877	Toluene	C7H8
2.07	93.68	1073485	Silanediol, dimethyl-	C2H8O2Si
3.59	91.73	282363	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.91	89.61	609532	unidentified C2-benzene	C8H10
4.38	95.29	1194517	Styrene	C8H8
4.83	96.18	575152	Ethanol, 2-butoxy-	C6H14O2
5.7	97.9	5076547	Benzaldehyde	C7H6O
5.89	87.65	1652211	Glycerin	C3H8O3
6.23	94.41	443687	unidentified C3-benzene	C9H12
6.3	93.89	4913880	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.37	94.06	670497	Octanal	C8H16O
6.52	95.02	416084	Benzene, 1,3-dichloro-	C6H4Cl2
6.58	89.28	790006	1-Propanol, 2-(2-methoxypropoxy)-	C7H16O3
6.73	93.78	2687015	Benzene, methyl(1-methylethyl)-	C10H14
6.77	97.17	11203694	1-Hexanol, 2-ethyl-	C8H18O
6.86	96.45	2493998	Benzyl Alcohol	C7H8O
7.38	96.99	963088	Ethanone, 1-phenyl-	C8H8O
7.88	93.96	1962988	Undecane	C11H24
7.95	97.21	6787460	Nonanal	C9H18O
8.1	87.76	4792325	Benzeneethanol	C8H10O
8.15	86.97	2855475	5-Ethyldecane	C12H26
8.3	88.62	2537081	Nonane, 4,5-dimethyl-	C11H24
8.39	89.66	1091701	Decane, 2,3,7-trimethyl-	C13H28
8.52	92.39	8135590	4-Piperidinol, 2,2,6,6-tetramethyl-	C9H19NO
8.65	94.9	2432536	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.72	96.09	28003723	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
8.78	90.29	877384	2,3-Dimethyldecane	C12H26
8.84	90.94	982772	Undecane, 3,4-dimethyl-	C13H28
8.87	87.93	744186	Acetic acid, phenylmethyl ester	C9H10O2
8.94	94.45	1601213	Undecane, 3-methyl-	C12H26

9.01	95.09	646735	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./.-.)-	C10H20O
9.19	87.63	964673	Azulene	C10H8
9.34	93.01	558932	Methyl salicylate	C8H8O3
9.37	94.84	2738126	Dodecane	C12H26
9.41	92.88	2900495	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.47	96.44	1529886	Decanal	C10H20O
9.58	95.45	11922042	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.78	89.85	1364986	Thieno[3,2-b]pyridine	C7H5NS
9.81	94.17	4258126	2-Ethylhexyl acrylate	C11H20O2
9.95	88.08	2121803	2-Ethyl-1-hexyl propionate	C11H22O2
10.03	93	571998	Pentasiloxane, dodecamethyl-	C12H36O4Si5
10.21	87.79	1841885	2,3-Diethyl-2,3-dimethylsuccinonitrile	C10H16N2
10.39	87.37	420267	1-Decanol	C10H22O
10.52	90.28	1953413	Benzene, 1,3-bis(1-methylethenyl)-	C12H14
10.67	94.92	2853131	1-Tridecene	C13H26
10.78	90.9	2420604	Tridecane	C13H28
11.17	96.19	27819189	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.55	88.8	3834268	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.73	88.98	1040384	Tridecane, 3-methyl-	C14H30
11.76	90.13	1101817	Ethanone, 1-(2,3-dihydro-1H-inden-5-yl)-	C11H12O
12.02	86	825368	1-Tetradecene	C14H28
12.12	94.8	4821908	Tetradecane	C14H30
12.25	95.21	812308	Dodecanal	C12H24O
12.34	86.56	616531	Longifolene	C15H24
12.76	89.5	2627006	1-Tetradecanol	C14H30O
12.87	95.87	2462816	1,2-Benzenedicarboxylic acid, dimethyl ester	C10H10O4
13.29	93.03	1727352	1-Pentadecene	C15H30
13.38	93.05	2751614	Pentadecane	C15H32
13.48	90.17	856646	bis(2-Ethylhexyl) ether	C16H34O
13.55	87.41	779905	Phenol, 2,4-bis(1,1-dimethylethyl)-	C14H22O
13.61	98.3	3134309	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O
14.03	88.85	889898	n-Nonylcyclohexane	C15H30
14.49	94.55	669614	1-Tricosene	C23H46
14.57	86.04	3433715	Hexadecane	C16H34
15.23	88.92	856843	Cyclopentane, nonyl-	C14H28
15.31	85.62	571655	Methyl octyl ether	C9H20O
15.38	87.72	3229479	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8